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FINAL REPORT

Evaluation of a Fluidized-Bed Paint Stripper at Red River Army Depot

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Hazardous waste minimization is one of the most pressing environmental issues facing the U.S. Army depots today. The U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) conducts research and development to support Army depots in developing programs and technologies to reduce the generation of hazardous waste. Degreasing and chemical paint removal processes at Army depots generate significant quantities of hazardous waste. Fluidized-bed paint stripping (FBPS), which has the potential to reduce the quantity of waste generated during paint removal, was selected by USATHAMA for a field demonstration. The FBPS was believed to have the potential to be substituted for the chemical paint stripping and degreasing of some parts. This report presents the results of a field evaluation of this technology conducted at the Red River Army Depot (RRAD). The following were the objectives of the demonstration tests:

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19. Abstract (continued)

- To determine whether the FBPS could be used to remove paint, grease, and oil from parts processed at RRAD.
- To develop operating parameters for the FBPS.
- To determine the impact of the FBPS on hazardous waste generation at RRAD and the relative cost of its use.
- To evaluate the air emissions from the FBPS operation.

The FBPS uses hot (600 to 1000°F) aluminum oxide (alumina) as a heat-transfer medium. Air passing up through the bed keeps the medium fluidized. The parts are lowered into the fluidized bed, where organic components of surface contamination and finishes pyrolyze into carbon oxides and other products of combustion (which are then completely combusted in an afterburner). The treated part retains a loosely adhering char made up of the inorganic components of its finish.

The unit tested was manufactured by Procedyne Corp. of New Brunswick, New Jersey. It consists of an electrically heated fluidized bed (Model PCS-4848), a fluidized-bed cooling station (Model QB-4848), a natural-gas-fired afterburner (Model AB-30-2), and a variable-throat venturi gas scrubber (W.W. Sly Manufacturing Co. Size 1). The system also includes a monorail hoist and emissions-control-equipment housing. Demonstration testing took place between November 1990 and March 1991.

The FBPS is not a suitable replacement for chlorinated solvent stripping systems currently used to remove paint from aluminum and aluminum alloy parts. When exposed to 700 to 800°F temperatures for the 1-hour residence time required to pyrolize paint, aluminum parts lost essentially all of their hardness (temper). A heat-treatment step could be added to re-temper these parts, but this would be impractical.

In most cases, the FBPS can remove paint from nonaluminum and non-heat-sensitive parts without affecting temper or causing warpage or shape distortion. However, not all non-aluminum, non-heat-sensitive parts can be processed in the FBPS. Some parts (e.g., thin vent covers) may be warped by the process. Additionally, this treatment is not suitable for parts with crevices, channels, or cavities that would retain the FBPS medium and thus be difficult to clean afterward (e.g., engine blocks). Therefore, FBPS cannot eliminate the need for caustic stripping. The cost per part for the FBPS treatment is 70 to 130 percent higher than for caustic stripping, depending on the number of shifts the FBPS is operated.

Metals present in paints and coatings stripped from parts accumulate in the fluidized-bed and will result in it being classified as a RCRA-characteristic hazardous waste. Inasmuch as the FBPS generates less waste on a per-part basis compared with caustic stripping, the overall amount of waste generated would be reduced regardless of the percentage of parts treated in the FBPS. Air emissions were controlled by the system and were within the constraints of the State permit. Scrubber water retained some of the metals, but it was acceptable for treatment in the onsite IWTP.

These conclusions are based on testing conducted under controlled conditions and non-continuous operation, and they should be verified by further analysis.

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ACKNOWLEDGMENTS

IT Environmental Programs, Inc. (ITEP, formerly PEI Associates, Inc.) prepared this report under contract to the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA). Mr. Ronald P. Jackson, Jr., was the USATHAMA Project Officer.

Personnel at Red River Army Depot (RRAD) provided site support, test parts, and facility operators to assist in the conduct of this project. Mr. Edward Hanna, Production Engineer, ITEP's contact at RRAD, coordinated the activities of RRAD personnel and site support. Mr. Johnny Gross, Supervisor at North Wash Rack, provided technical manuals, test parts, and site support for the testing. Mr. Isaac Pichard, a North Wash Rack operator, was trained by Procedyne Corporation (the manufacturer of the fluidized-bed paint stripper) and operated the equipment throughout the testing.

Richard W. Gerstle served as ITEP's Project Director, and Robert A. Ressl was the Project Manager. Additional technical input was provided by John Spessard, David Pomerantz, Cindy Shires, and Jeffrey Davis.

SECTION 1

INTRODUCTION

Hazardous waste minimization is one of the most pressing environmental issues facing U.S. Army depots today. The U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) conducts research and development to support Army depots in the development of programs and technologies to reduce the generation of hazardous waste. Degreasing and chemical paint removal processes conducted at Army depots generate significant quantities of hazardous waste. Fluidized-bed paint stripping (FBPS), which has the potential of reducing waste generated during paint removal, was selected by USATHAMA for a field demonstration. For some parts, the FBPS has the potential for being substituted for caustic stripping and degreasing. This report incorporates the results of a field evaluation of this technology conducted at the Red River Army Depot (RRAD). IT Environmental Programs, Inc., performed this evaluation under contract to USATHAMA.

The objectives of the demonstration tests were as follows:

1) To determine whether the FBPS could be used to remove paint, grease, and oil from parts processed at RRAD.

2) To develop operating parameters for the FBPS.

3) To determine the impact of the FBPS on hazardous waste generation at RRAD and its relative cost.

4) To evaluate air emissions generated by the FBPS operation.

The fluidized-bed technology was originally developed as a heat-treating method for metal parts rather than for the removal of paint or organic material. The main advantages of the fluidized bed over simple atmospheric heat-treatment furnaces are a

superior heat-transfer rate and the precise control of temperatures and atmospheres in the heat-treatment furnace. More recently, the FBPS technology has been used primarily for cleaning paint application equipment and fixtures and for removal of plastics from injection molding dies. In most of these applications, the parts processed are made of similar metals and have similar surface coatings. As a paint and grease stripper, the FBPS is simpler to operate than other alternatives (e.g., a molten salt bath). A major advantage FBPS offers is the possibility of replacing at least some of the toxic chemicals now used to remove paint and grease. A disadvantage of FBPS is that it generates carbon monoxide and unburned hydrocarbons because the concentration of oxygen in the fluidizing air is inadequate to allow complete combustion of the paint constituents, plastic coatings, or rubber. Precautions are taken, however, to prevent a buildup of pyrolysis products that could be combustible and/or explosive. Another disadvantage is that not all metal parts can be treated in the FBPS.

Activities at RRAD include vehicle repair, small arms repair, equipment stocking programs, and warehousing. One of the primary activities, repair of Army vehicles, includes two basic programs: 1) inspection and repair, and 2) complete rebuilding of vehicles and components. The inspection and repair program entails disassembling the vehicle and repairing those components that need repair. The rebuilding program entails complete disassembly of the vehicle, replacement or refurbishment of all components, and reassembly. Both programs involve paint-stripping operations that generate wastes.

The type of vehicles processed at RRAD varies. For example, during the Middle East conflict in 1990 and 1991, depot activities changed from the predominant task of complete rebuilds of the Type 113 family of vehicles to the exclusive task of inspecting and repairing Bradley fighting vehicles. A description of activities conducted at RRAD is included in Appendix A.

Section 2 of this report describes the FBPS process, equipment, and operation. Section 3 describes the demonstration testing performed under this task. Section 4 compares the FBPS with existing parts-cleaning processes used at RRAD. Section 5 presents the conclusions drawn from the FBPS demonstration and evaluation at RRAD.

SECTION 2

FLUIDIZED-BED PAINT STRIPPER

The FBPS process uses hot (600 to 1000 °F) aluminum oxide (alumina) as a heat-transfer medium. Air passing up through the bed keeps the media fluidized. Parts to be cleaned are lowered into the fluidized bed, which quickly heats the part and its surface coatings (paint, grease, oil, etc.) to a temperature at which organic components of surface contamination and finishes pyrolyze into carbon oxides and other products of combustion. Emissions from the process are completely combusted in an afterburner. The treated part retains a loosely adhering char made up of the inorganic components of its finish.

This section describes the specific FBPS evaluated at RRAD. This unit, manufactured by Procedyne Corp. of New Brunswick, New Jersey, consists of an electrically heated fluidized bed (Model PCS-4848), a fluidized-bed cooling station (Model QB-4848), a natural-gas-fired afterburner (Model AB-30-2), and a variable-throat venturi gas scrubber (W.W. Sly Manufacturing Co. Size 1). The system also includes a monorail hoist and housing for the emissions-control equipment. The general arrangement of the system is shown in Figures 2-1 and 2-2.

2.1 Fluidized Beds

Two distinct beds are used in the system: a hot bed and a cold bed. The hot bed, where pyrolysis of the coatings takes place, is kept at operating temperature by electric heaters wrapped around the vessel. Although the cold bed is similar to the hot bed in terms of fluidization, it is surrounded by a cooling-water jacket instead of a series of electrical heaters. The cold bed is used to cool the parts after the organics have been pyrolyzed. The hot and cold beds each have diameters of 48 inches and

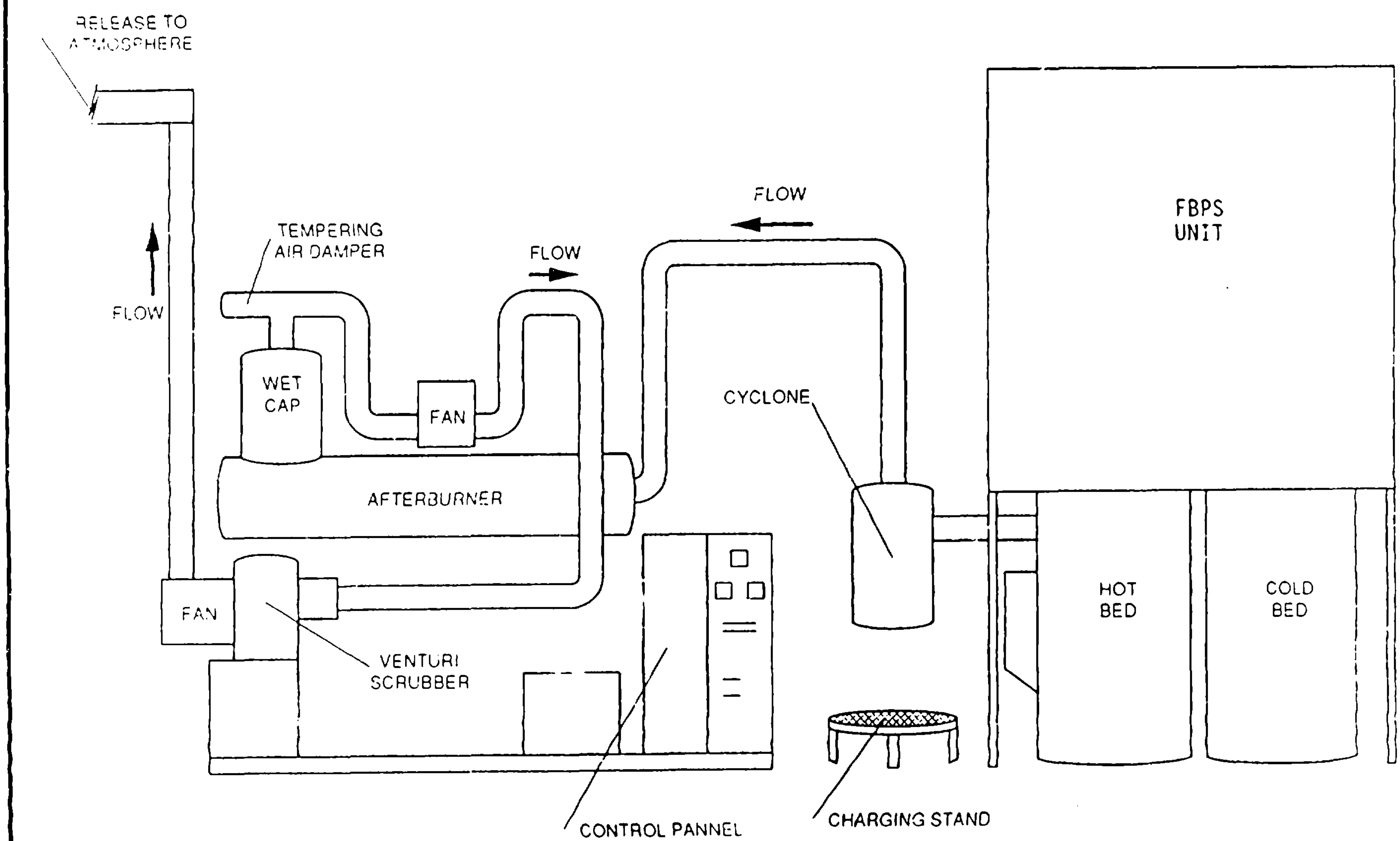

Figure 2-1. General arrangement of the FBPS installed at RRAD.

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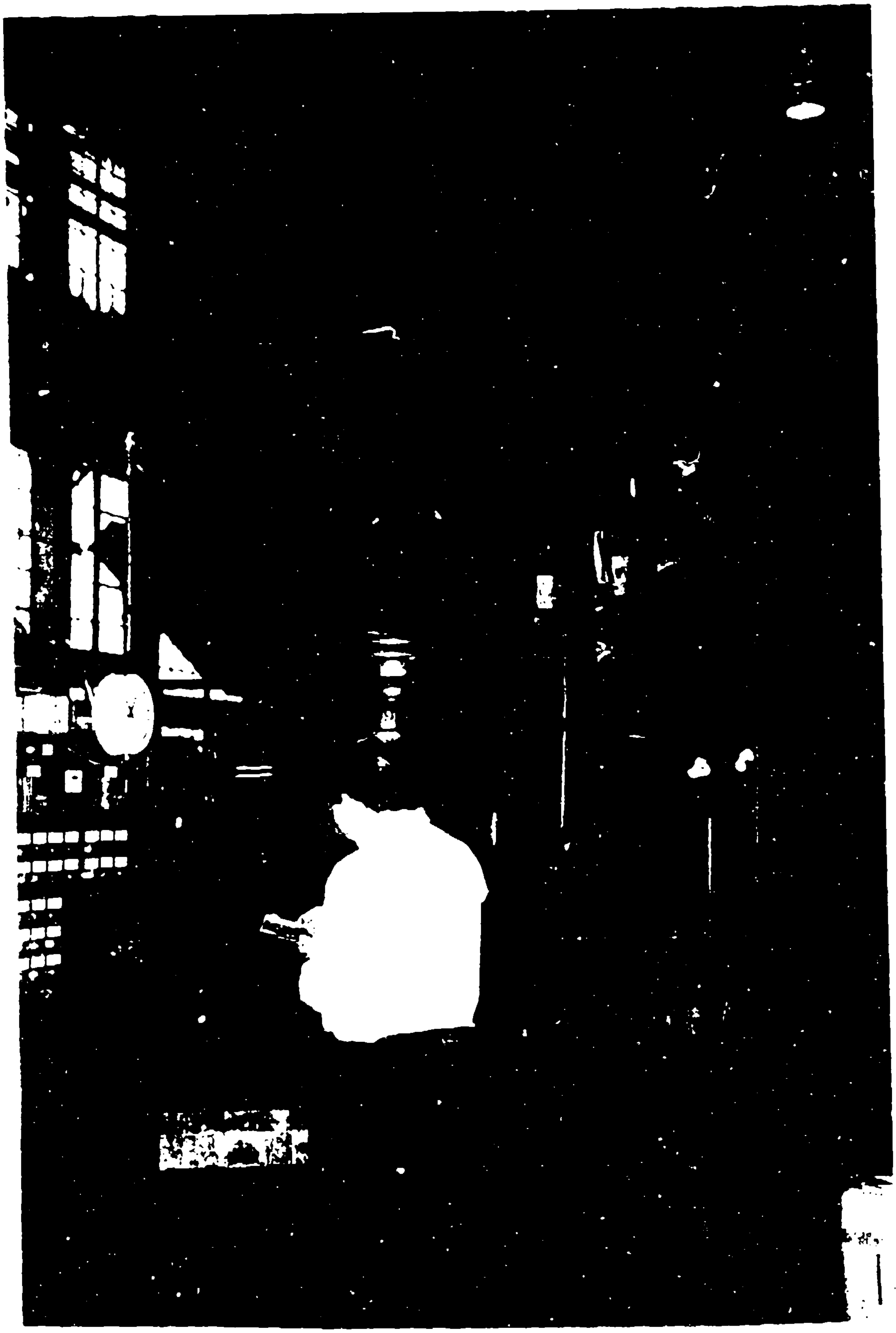

Figure 2-2. Parts load being lifted into the FBPS.

effective bed depths of 48 inches. An electric chain hoist on a monorail located above the bed is used to raise and lower parts into the FBPS for treatment (Figure 2-3).

The Procedyne FBPS equipment uses a patented arrangement of air diffusion nozzles and a diffusion plate to achieve fluidization. The nozzles are arranged in a uniform pattern in the diffusion plate, which is welded into the bottom of the fluidizing vessel. The installed unit uses 200-mesh alumina in the bed and uses air as the fluidizing gas. Alumina has the advantage of being chemically nonreactive and available in the required size and density range. Other nonreacting materials, such as silicon dioxide (silica) and titanium dioxide (titania) or alumina of a different mesh size could be used, but some modifications (e.g., different air velocities) would be required. Although other gases (e.g., nitrogen or carbon dioxide) could be used as fluidizing gases, air has the advantages of being readily available and providing the oxygen required for pyrolysis of organic matter in the coatings.

While the parts are in the hot bed, some surface coatings may come off the parts as flakes; these flakes generally float on top of the fluidized bed. A photograph of a hot bed in its fluidized state (Figure 2-4) shows "bubbles" of sand on top of the bed and a small accumulation of removed surface coatings. Parts that become dislodged from the parts basket fall into the fluidized bed and sink to the bottom, where they remain until the bed medium is replaced.

During the processing of a normal load of parts, the concentration of oxygen in the fluidizing air will be inadequate to allow complete combustion of the paint constituents, plastic coatings, or rubber. Therefore, carbon monoxide and unburned hydrocarbons will be generated during pyrolysis of these materials. The products of pyrolysis are combustible volatile organic compounds (VOCs), which are burned in the system's afterburner. Low-pressure steam is bled into the space above the fluidized bed. The steam prevents a buildup of pyrolysis products that could be combustible and/or explosive. As a further precaution, the hot bed is equipped with an explosion vent (Figure 2-5). The furnace housing (Figure 2-2) is used to control emissions during loading and unloading operations that occur while the lid is removed from the hot and cold fluidized beds.

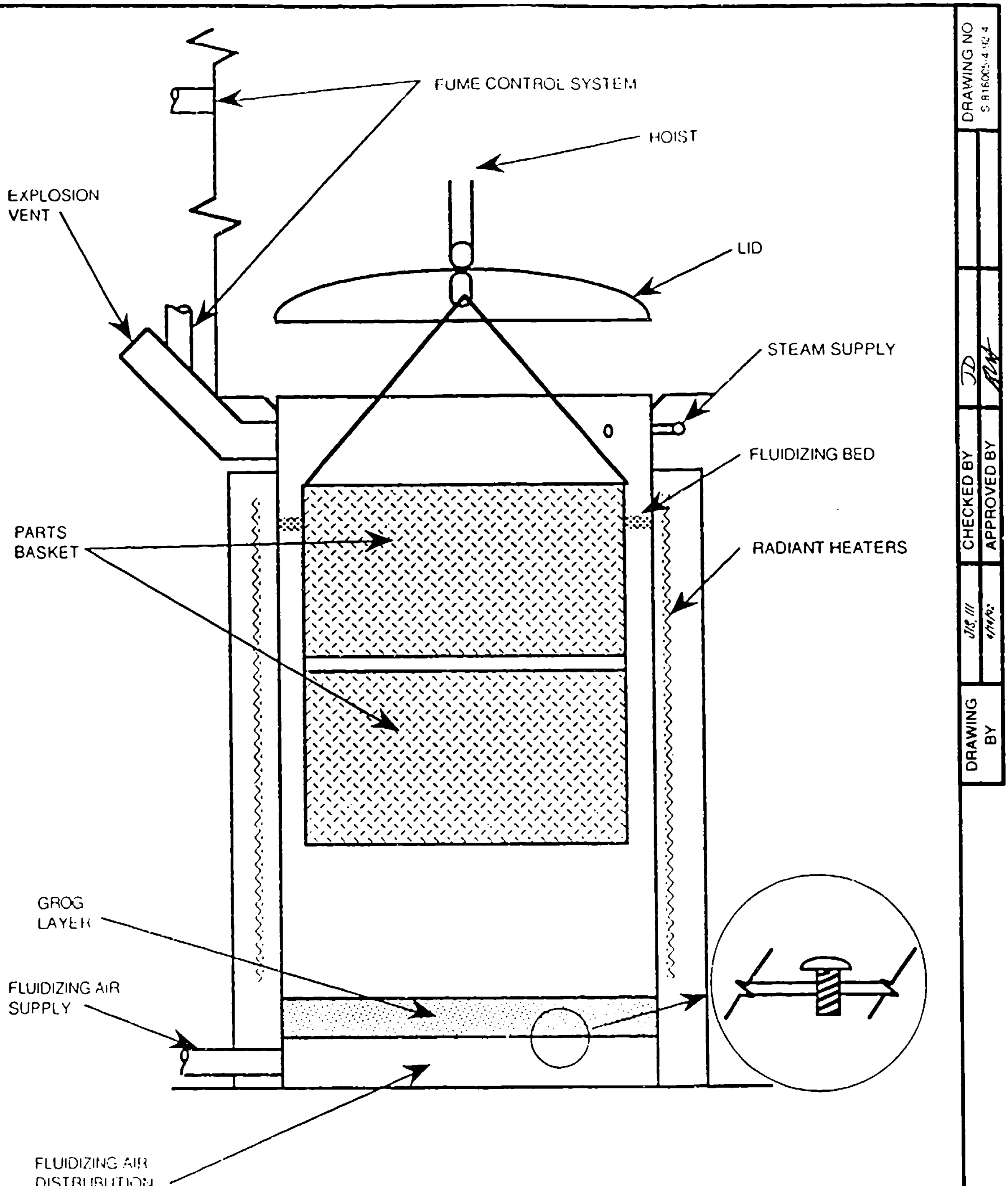

Figure 2-3. Section through FBPS showing major features.

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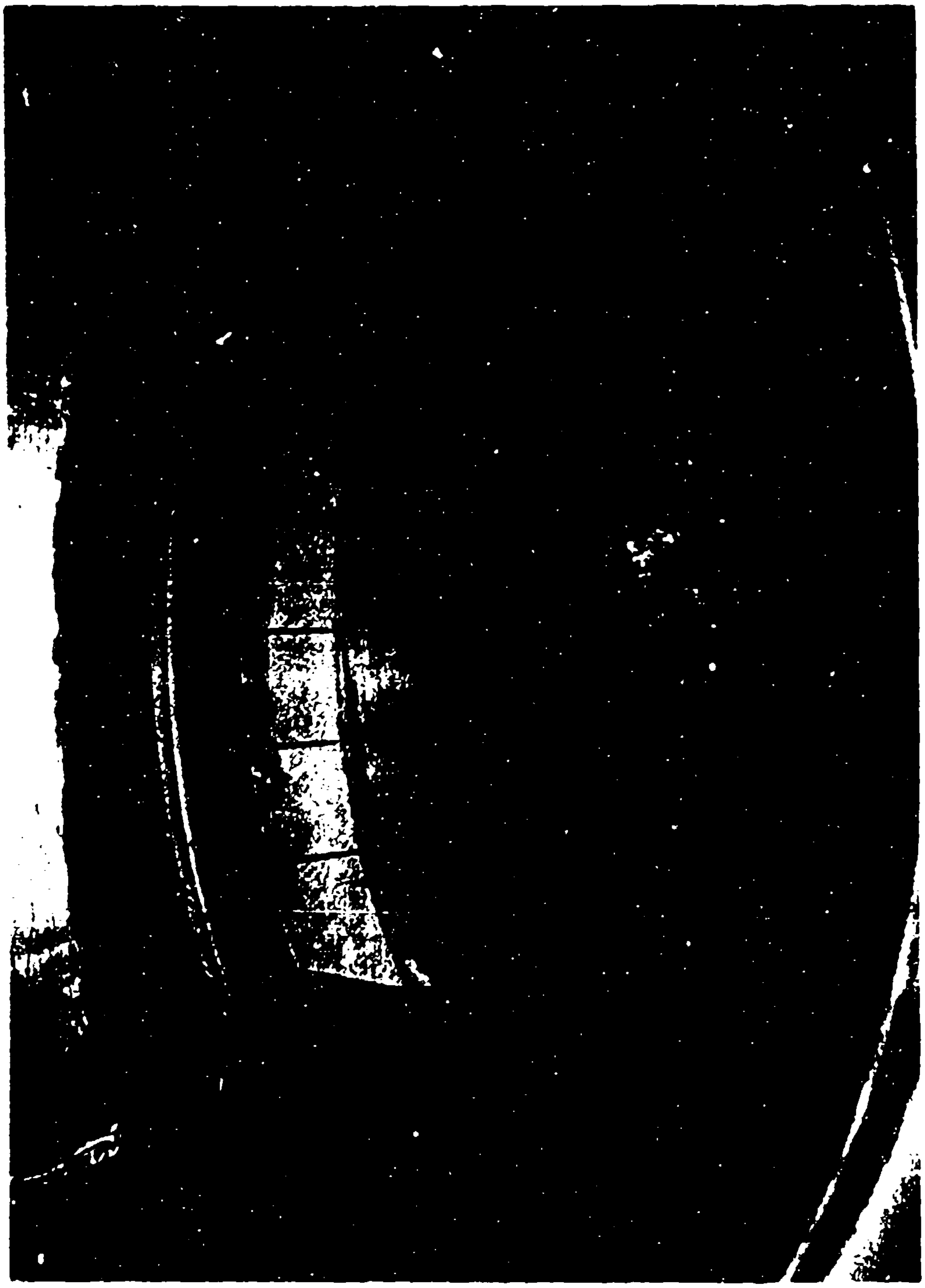

Figure 2-4. Fluidizing hot bed.

Figure 2-5. Explosion vent.

During the lowering of the parts into the fluidized bed, the lid of the bed is removed. Therefore, any fumes that are carried up and out of the bed escape the primary fume capture system and are contained by the furnace housing. Once the lid is in place, these emissions are gradually evacuated from the housing. They are then combined with the other emissions from the hot bed and burned in the afterburner.

The furnace housing is an integral part of the support mechanism for the overhead monorail and hoist. The hoist raises and lowers baskets full of parts into and out of the hot and cold fluidized beds. The monorail provides a track for the hoist that moves the parts baskets from the loading and unloading areas to the hot and cold beds. The chain for the hoist passes through a narrow slot at the top of the furnace housing. This slot is sealed with rubber flaps, and the doors at each end of the housing are closed before the baskets are put into the furnace so as to control fugitive emissions; however, some emissions do escape. The housing has two 12-in.^{2} side windows and an interior light to provide visibility for the operator.

During normal operation, parts are placed in one of four baskets having an inside diameter of 45 in. and an inside depth of 22 in. The baskets can be modified to accommodate specific parts. The 45-inch inside diameter restricts the size of parts that can be processed in the FBPS baskets; however, larger parts can be hung by a chain and lowered directly into the beds without the use of the baskets.

2.2 Emission Control System

The afterburner can heat air emissions to 1400°F and introduce sufficient excess air to burn VOCs completely. The afterburner provides a 0.4-second retention time for the gases, which insures complete combustion. At 1400°F, typical VOC pollutants are destroyed in 0.1 second in the afterburner. (Exceptions include black smoke and carbon particulates greater than 10 μm in diameter, which may require up to 1 second at 1400°F to be destroyed fully.) Afterburners are normally designed with a 0.3- to 0.5-second residence time for a safety factor. Texas Air Control Board (TACB) regulations require afterburners to be designed on the basis of a 0.4-second residence time at 1400°F. A "wet cap" attached to the discharge end of the afterburner cools

the discharge gases to approximately 150 °F. This cooling permits the use of lower-temperature blowers and ducts for the system's exhaust. A pilot flame is maintained in a low-fire mode to insure that no unsafe flameout conditions occur as a result of a temporary drop in fume concentration in the process off-gas or a temporary interruption of the off-gas stream.

The RRAD FBPS has a variable-throat wet venturi scrubber designed for a pressure drop of 4 inches. The adjustable-throat feature optimizes scrubbing efficiency by maintaining the optimum pressure drop for removal of particulates and absorbing gaseous pollutants. This, combined with the unit's energy-regaining section, significantly reduces power consumption and operating costs.

2.3 System Controls

The following controls are installed on the FBPS system at RRAD:

- Hot-bed temperature controller and manual fluidizing air control.
- Cooling-bed water on/off and manual fluidizing air control.
- Afterburner temperature control and manual wet cap water control.
- Manual venturi throat adjustor and waterflow control.
- Automatic system monitor for low hot-bed fluidization, low afterburner gas flow or flameout, and afterburner overtemperature.

The hot-bed temperature controller controls the flow of electricity to the heaters, which in turn control the hot-bed temperature. Automatic shutoff controls prevent overheating. Off/on controls on the cold-bed water jacket conserve cooling water when the cold bed is not in service. Manual fluidizing air controls are used to maintain the hot- and cold-bed airflow and to keep the beds fluidized. Temperature sensors and controls on the afterburner monitor the incinerator operation, and the manual waterflow controls on the water cap maintain the afterburner gas discharge temperature at 150 °F. The venturi scrubber has a manually operated, adjustable, venturi throat opening and waterflow controls. The FBPS has automatic monitors with automatic shutoffs for hot-bed operating parameters. Figure 2-6 is a photograph of the FBPS control panel.

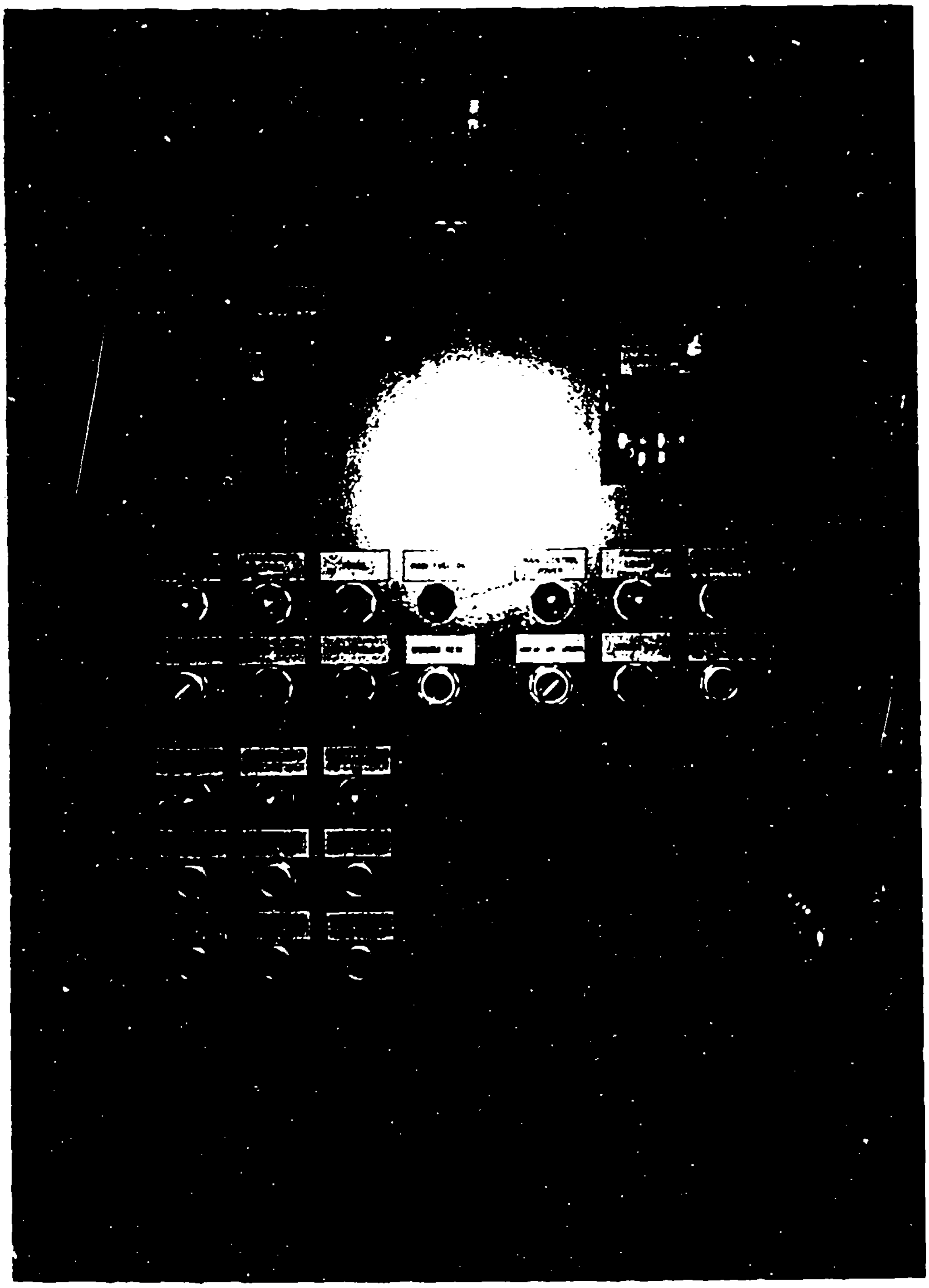

Figure 2-6. FBPS control panel.

Procedures for startup of the FBPS are as follows:

- Turn the bed heaters on.
- When the bed reaches the desired temperature, start the afterburner.
- When the afterburner reaches the required temperature, the hoist can be operated.
- Turn cooling-bed water and air on manually as needed.
- When the system is operating, turn on the wet cap and venturi water supply.

An alarm will sound if the temperature of the afterburner exhaust exceeds set limits. Fluidizing air is shut off automatically if the afterburner shuts down.

2.4 Equipment Purchase and Installation

Although fluidized-bed technology has been used in petroleum refineries, chemical reactors, combustion processes, and metal heat-treating processes, its use for paint removal is a relatively new development; therefore, only three potential equipment vendors were identified. Of these three, only Procedyne Corporation had installed equipment in the United States and was able to provide the necessary support for installing the equipment and training the operators. Procedyne's primary involvement with the fluidized-bed technology has been for metal heat treatment.

As described in the following paragraphs, a few equipment and procedural modifications were made to the FBPS system installed at RRAD. First, interior lighting was installed in the closed cabinet, which enables operators to view and position the baskets properly. The low-pressure steam-injection system mentioned earlier in this section was an add-on design incorporated to prevent the accumulation of ignitable hydrocarbon vapors above the hot bed. This safety feature is intended to prevent explosions caused by ignition of the confined VOCs.

The FBPS purchased for this demonstration is the type typically used for heat-treating metal parts; it was redesigned for this application. When this system is used for heat treatment, bed media are replaced infrequently. Because bed media in an FBPS operated as a paint stripper (such as the one at RRAD) will be replaced more frequently, provisions should be made to simplify bed changeouts. As-built drawings should be requested for the equipment at the time of purchase. Such drawings are

necessary for those who purchase a fluidized bed for paint stripping, as they are less likely to be familiar with the equipment and its utility requirements than are purchasers from the metal heat-treating industry. The Procedyne FBPS equipment was skid-mounted and modularized, which facilitated field assembly.

SECTION 3

DEMONSTRATION TESTING

Demonstration testing of the FBPS took place at RRAD between November 1990 and March 1991. During this time, approximately 35 tests were run on parts. Tests were also run on scrap parts, paint hooks, and panels to determine optimum temperatures for the removal of various types of paints.

This section covers the field testing, the character of the parts encountered at RRAD, the operating parameters, and the test results. Some equipment testing performed at the manufacturer's facility and metallurgical testing performed by an independent laboratory are also discussed. A copy of the detailed test plan prepared prior to testing is presented in Appendix B.

3.1 Test Plan

The primary objectives of the field testing were to determine to what extent the FBPS can replace chemical paint stripping, to establish when it can be used to remove other organic coatings (e.g., oils and grease), and to determine its effects on waste generation. Secondary objectives of the field testing were to establish specific operating conditions for the parts and coating systems processed in the FBPS and to train RRAD personnel to operate the system.

The first step involved categorizing the parts processed at RRAD and identifying those that would be suitable candidates for testing in the FBPS. When available, part specification drawings were used to obtain the following information about the parts:

- The metal alloys used
- Any metal treatment (e.g., heat treatment and hardening)
- Electroplated coatings
- Conversion coatings

- Type of paint used
- Welds, soldering, brazing, and other treatments that could be affected by processing in the FBPS

The test program established which parts processed in the FBPS could be repainted and returned to service and how the current RRAD procedures would have to be modified to accomplish this. The test program also established optimum FBPS operating parameters and how these parameters would have to be modified based on what was being processed in the FBPS. Postprocess testing of parts processed in the FBPS included hardness testing, checking for changes in part dimensions, and visual examinations for warping, staining, and other damage.

The second step of the test plan involved characterization of air emissions and wastes generated by the FBPS. Metals present in coatings and removed in the FBPS could contribute to both hazardous waste generation and air emissions. These metals could 1) leave the FBPS with the part (which means the downstream processing would have to deal with their disposal); 2) contaminate the fluidizing medium (which would require eventual disposal of the medium); 3) be deposited inside the FBPS (which would force an eventual shutdown and cleaning); or 4) exit the FBPS with the exhaust gas (which could become air emissions). Air emissions of VOCs, metals, and particulates were measured, and the fate of heavy metals and combustible paint char was determined. Based on environmental sampling data (Subsection 3.3), the water scrubber and incinerator provide adequate control of emissions.

3.2 Test Results

3.2.1 Effects on Paints and Coatings

Some scrap parts were tested (production parts were not available) to determine the effectiveness of the fluidized bed in the removal of paints and coatings found at RRAD. The parts tested were aluminum brackets used for a chair replacement and a seat belt replacement. Because several of these parts were available in three or four coating types, they provided an excellent source of test materials for investigation of the effect of temperature on the various coatings.

The effectiveness of the FBPS on these parts was evaluated by using a standardized procedure to abrade the surface of the part after it was processed in the FBPS. This procedure entailed the use of a commercially available scouring pad from the Scotch Company, which is commonly used as a cleaning pad at the depot. This pad, which consists of an abrasive material on a nylon webbing matrix, is typically used to spot-clean corrosion off of metal parts. The test procedure consisted of treating parts in the FBPS at specific temperatures believed to bracket the optimum operating temperature for the particular paint. The processed part was removed from the FBPS and cleaned with the test pads to remove the char. The relative effort required to remove the char (i.e., the number of strokes required to clean the part) was recorded. This information served as an indicator of the effectiveness of the FBPS in breaking down the paint. Table 3-1 shows the results of this testing. These data demonstrate that a temperature of 750°F and a 1-hour residence time were adequate to char the paint systems sufficiently to provide a cleanable part. Although some coatings were effectively treated at lower temperatures and shorter times, 750°F for 1 hour appeared to be the minimum temperature and time capable of producing reliable results for all coatings.

3.2.2 Effects on Base Metal

The FBPS treatment can definitely affect the characteristics of the part's base metal. Warpage and shape distortion can occur and render the part useless. The FBPS treatment can also alter the heat treatment or temper of the metal. Tests demonstrated that aluminum parts could not be treated in the FBPS because, in all cases, the process softened the metal. This effect is shown in Table 3-2, which presents selected hardness data on typical aluminum parts processed in the FBPS. Appendix C presents a list of the metal parts evaluated during this project, which includes the aluminum parts evaluated and rejected for processing in the FBPS. In general, the only parts suitable for FBPS treatment are those made of steels that are not heat-treated or steels on which heat-treatment temperatures are high enough to preclude their being affected by processing in the FBPS.

TABLE 3-1. EFFECTS OF TEMPERATURE AND TREATMENT DURATION ON PAINT REMOVAL

Test number	Test temperature, °F	Test time, h	Part number	Relative removal efficiency[a]
Enamel paint systems				
9	600	1	8787	50
10	600	3	8779	200
11	600	6	8783	150
11	600	6	8784	200
14	700	1	8760	5
13	700	3	8761	3
21	775	0.75	8744	25
21	775	0.75	8743	0
22	800	0.5	8739	6
17	800	1	8759	3
15	800	3	8758	50
Epoxy paint systems				
9	600	1	8785	200
9	600	1	8786	200
10	600	3	8780	200
10	600	3	8781	200
11	600	6	8782	200
14	700	1	8764	100
14	700	1	8775	25
14	700	1	8762	40
14	700	1	8770	200
14	700	1	8771	70
13	700	3	8776	60
13	700	3	8768	45
19	725	2	8754	0
19	725	2	8756	0
19	725	2	8753	0
19	725	2	8755	0

(continued)

TABLE 3-1 (continued)

Test number	Test temperature, °F	Test time, h	Part number	Relative removal efficiency[a]
19	725	2	8755	0
19	725	2	8752	3
20	750	1	8774	3
20	750	1	8749	1
20	750	1	8750	3
21	775	0.75	8747	3
21	775	0.75	8737	15
21	775	0.75	8736	20
21	775	0.75	8745	3
21	775	0.75	8751	10
22	800	0.5	3740	0
22	800	0.5	8738	6
17	800	1	8777	5
17	800	1	8763	10
17	800	1	8772	1
15	800	3	8767	50
15	800	3	8765	20
15	800	3	8773	10
15	800	3	8769	0

[a] Relative paint removal efficiency indicates the ease with which char was removed from the treated part. The greater the number, the more difficult the removal, which means less-efficient treatment. A zero indicates all char was removed by the FBPS. The highest possible number to indicate the degree of removal difficulty is 200.

TABLE 3-2. EFFECT OF FBPS TREATMENT ON ALUMINUM PARTS

Part number	Description	Hardness Rockwell "B"	
		Before	After
5127238	Air horn	35	20
5133296	Air horn base	35	0
8763560	Spring spool	40	0
10232625	Access door	36	0
10943071	Battery rack	35	0
10949605	Fuel cell cover	30	0
12292439	Motor support	38	0
12292441	Motor clamp	27	0
12298112	Safety handle	10	0

Five steel parts routinely processed at RRAD (Table 3-3) were considered good candidates for FBPS treatment. Not only are these parts typical of the kinds of parts most suitable for processing in the FBPS, they were also available in sufficient quantity for use in this evaluation. The hardness data presented in Table 3-3 demonstrate that the parts listed (except for the bearings) are unaffected by FBPS processing. The bearings are not suitable for this treatment because the FBPS processing will destroy the oil impregnation and possibly alter the shape or temper of the bearings.

TABLE 3-3. EFFECTS OF FBPS TREATMENT ON STEEL PARTS

Assembly item number and description	Part number	Part description	Steel alloy	Hardness (Rockwell "C")[a] Before	After
P/N 12253143 Idler arm	10866131	Spindle	4140H	36.4	37.2
	12253144	Arm	4140H	35.7	36.0
	11633894	Bearing	0L16	31.9	33.0
P/N 12268700 Road wheel arm assembly	11660930	Trunion	4140H	32.5	32.8
	8756363	Arm	FS4145H	33.6	33.9
	10866123	Spindle	4140H	33.7	33.5
	MS35624-50	Plug	Unknown	35.1	34.6
P/N 12253578 Idler arm	11669367	Spindle	FS4142	40.0	39.7
	11669358	Housing	4140H	38.5	38.2
	11669365	Bearing	0L16	80.0[b]	67.7[b]
P/N 12276657 Road wheel housing support	12276657	Housing	FS4130	36.7	36.7
		Bearing	0L16	68.8[b]	68.2[b]
P/N 10918159 Road wheel housing support	10918160	Housing	CSGRD115-95	28.9	28.9

[a] All parts were sectioned, and metallurgical samples were prepared from the sections. One-half of the section was tested, and the results were reported as the "before"; the other half was processed in the FBPS for 1 hour at 800°F before being tested, and the results were reported as the "after" measurement.

[b] Results are reported as Rockwell hardness "B" scale.

The relationship between hardness and temperature for a specific alloy can be determined from standard material handbooks. These data can be used to determine whether the FBPS processing will affect the metal. Figure 3-1 shows this hardness-versus-temperature relationship for 4140 low-alloy steel. The figure demonstrates that a Rockwell "C" hardness of 45 is achieved at 800°F. A part [e.g., Part No. 11660930 - Trunion (Table 3-3)] would be unaffected by FBPS treatment at 800°F because its Rockwell "C" hardness (33) is below curve. Similar data for the remaining parts are also available.

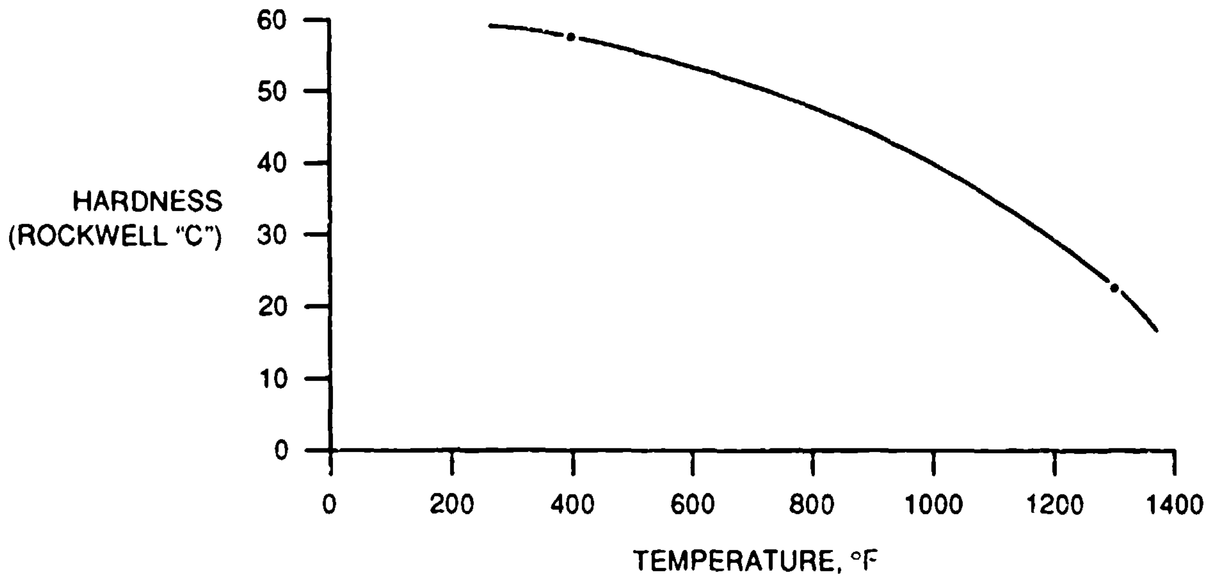

Figure 3-1. Rockwell hardness vs. temperature for 4140 low-alloy steels.

3.2.3 Effect on Parts Processing

The only special preprocessing required prior to FBPS treatment is the removal of significant organic components (e.g., large fabric sections or rubber sections) that may be present on the part. Processing of parts after paint stripping would be virtually unchanged by incorporation of the FBPS. The one exception to this is the need to remove any bed media remaining in or on the part. This would only be a concern for parts that have internal machined or bearing surfaces or parts containing small passages that could become clogged with the bed media and therefore require special cleaning. For example, engine heads and blocks would not be suitable candidates for FBPS processing because they contain numerous small passages and internal cavities.

The FBPS would not entirely eliminate either of the existing chemical paint-stripping processes at RRAD. Each process (methylene chloride and caustic stripping) would still be needed for parts that are not suitable for processing in the FBPS. Because the aluminum parts found at RRAD are heat-treated, they cannot be processed in the FBPS and would continue to be processed in the methylene chloride paint-stripping process. The FBPS would reduce the number of steel parts stripped in the caustic stripping process. A comparison of the quantities of waste generated by these stripping methods is presented in Section 4.

Parts processed in the fluidized bed were found to require a followup white metal blasting that took about the same length of time as the blasting required after chemical stripping. Parts having machined surfaces (e.g., road arms) do not require blasting; these parts are chemically treated and then cleaned by hand. When these types of parts were processed in the FBPS, however, the final hand-cleaning operation was found to be unnecessary. Road arms that were processed in the FBPS, however, had to be processed with a corrosion remover because the fluidized bed had little or no effect on corrosion removal.

3.3 Environmental Emissions Measurements

Evaluation of environmental emissions was part of the overall evaluation of the FBPS (see Appendix D). The FBPS generates the following waste streams: 1) air exhaust from the afterburner and scrubber systems, 2) water discharge from the scrubber system, 3) dust collected in the cyclone separator on the ventilation system between the fluidized bed and the afterburner, and 4) fluidized-bed media. These environmental measurements were made over a relatively short test period. The types and number of parts processed and the kinds of paints treated during this test may not be representative of the types and number that would be routinely processed if the FBPS were operated continuously during regular production. Therefore, the measurements (i.e., quantification of metals in discharges) can only serve as indicators of waste-stream characteristics.

Table 3-4 presents the quantities of four metals (cadmium, chromium, lead, and zinc) found in the afterburner and scrubber system exhaust air. These data indicate that controlled emissions of each of these metals from the FBPS would be less than 0.5 lb/h. Emissions from the FBPS are regulated under the Texas Air Control Board's Standard Exemption No. 87, which covers heat-cleaning devices. This Standard Exemption limits the emission of any air contaminant to a maximum of 0.5 lb/h and 2.0 tons/yr. Atmospheric emission testing indicated that the incinerator completely burned essentially all organic matter and that the FBPS is not a significant source of VOC emissions (Appendix D). These results are consistent with the process operating parameters submitted to the Texas Air Control Board when the unit was installed and permitted for operation.

Table 3-5 presents results of sampling for these same metals in the liquid effluent from the scrubber system. Concentrations of metals in this discharge are acceptable for treatment at the industrial wastewater treatment plant located at RRAD.

Table 3-6 presents analyses of metals in the fluidized-bed media contained in the hot bed and the cold bed, and the media collected in the cyclone separator. This material (particularly the cyclone separator dust) is contaminated with metals that could make it a RCRA-characteristic hazardous waste. Although the Toxic

TABLE 3-4. SUMMARY OF ATMOSPHERIC EMISSIONS OF PARTICULATES AND METALS[a]

		Particulate emissions			Metals emissions							
		Concentration			Concentration, µg/m³				Mass emission rate, lb/h			
Test No.	Date (1991)	gr/dscf[b]	mg/m³	Mass emission rate, lb/h	Cd	Cr	Pb	Zn	Cd	Cr	Pb	Zn
SOPM-1[c]	2/26	0.13	297.5	0.80	30	373	574	861	$7.9E^{-5}$	$9.7E^{-4}$	$1.5E^{-3}$	$2.2E^{-3}$
SOPM-2	2/26	0.007	15.8	0.047	12.4	<4[d]	17.6	<6.5	$3.7E^{-5}$	$<1.1E^{-5}$	$5.2E^{-5}$	$<1.9E^{-5}$
SOPM-3	2/27	0.004	8.2	0.024	6	<2.8	4.9	<4.7	$1.8E^{-5}$	$<8.4E^{-6}$	$1.4E^{-5}$	$<1.4E^{-5}$
SOPM-4	2/27	0.0037	8.4	0.023	<2.1	<3.2	3.7	<5.3	$<5.9E^{-6}$	$<8.8E^{-6}$	$1.0E^{-5}$	$<1.5E^{-5}$
SOPM-5	2/27	0.013	28.8	0.083	2.2	<2.9	10.1	34.5	$6.3E^{-6}$	$<8.2E^{-5}$	$2.9E^{-6}$	$9.9E^{-5}$
SOPM-6	2/28	0.0037	8.4	0.024	9.3	<2.9	16.1	4.8	$2.6E^{-5}$	$8.2E^{-6}$	$4.5E^{-5}$	$1.4E^{-5}$
SOPM-7	2/28	0.0028	6.4	0.019	<1.9	10	18.8	14.4	$5.5E^{-6}$	$2.9E^{-5}$	$5.4E^{-5}$	$4.2E^{-5}$
SOPM-8	2/28	0.0040	9.1	0.026	12.4	<3	9.5	13.8	$3.5E^{-5}$	$<8.4E^{-6}$	$2.7E^{-5}$	$3.9E^{-5}$

[a] The Texas Air Control Board's Standard Exemption No. 87 for Heat Cleaning Devices limits emissions of any contaminant to 0.5 lb/h.

[b] gr/dscf = grains per dry standard cubic foot.

[c] Test SOPM-1 is considered nonrepresentative because of a scrubber upset. It does, however, provide an indication of potential uncontrolled emissions.

[d] *Less than (<) denotes value is below the method detection limit (MDL), which is the value following the "<" sign.* MDLs are determined in part by the volume of gas sampled. This volume varied among the tests; therefore, the MDLs show some variation.

TABLE 3-5. TOTAL METALS IN THE SCRUBBER EFFLUENT[a] (mg/L)

Sample ID	Cadmium	Chromium	Lead	Zinc
30	0.004	0.083	<0.02	0.082
31	0.002	0.030	0.0041	0.031
32	<0.002	0.007	0.0007	0.021
34	0.007	0.064	<0.02	0.20
Detection limit	0.002	0.006	0.02	0.008

[a] The samples were collected as a series of grab sampling during the emission tests. Samples 30 and 34 were taken while cadmium- and zinc-plated parts were being processed in the FBPS, and Sample 32 was collected while aluminum-plated parts were being processed.

TABLE 3-6. ANALYSIS OF METALS IN THE FLUIDIZED-BED MEDIA[a] (mg/g)

Sample description	Cadmium	Chromium	Lead	Zinc
Virgin material	<0.2	9.8	0.7	2.9
Cold-bed pretest	1.7	13	18	16
Cold-bed posttest	2.8	15	23	22
Hot-bed pretest	5.5	24	23	34
Hot-bed posttest	26.7	14.3	25.9	38.4
Cyclone dust	40.4	35.1	77.5	161
Detection limit	0.2	0.3	0.4	0.5

[a] Results are for total metals.

Characteristic Leaching Procedure (TCLP) test was not conducted on these materials, a similar study conducted at Letterkenny Army Depot demonstrated that fluidized-bed media was quickly contaminated with metals and was a RCRA hazardous waste. It is estimated that about 800 pounds of this dust would be collected per year, based on continuous operation of the FBPS (8760 hours per year).

Total metals analyses of the aluminum oxide fluid media are also presented in Table 3-6. These analyses indicate that metals do build up in this media; however, it cannot be determined if the levels at the time of media change-out would be sufficient to require the sand to be disposed of as a RCRA-characteristic hazardous waste. A complete change-out of the bed media would amount to about 8000 pounds of material. Based on information acquired during the test program, it is estimated that the media would require change-out every other year.

SECTION 4

SYSTEM COMPARISONS

For comparison purposes, this section presents operational, waste generation, and cost data for each of the two paint-stripping systems evaluated at RRAD--the FBPS and aqueous caustic paint stripping--which represent two alternatives for stripping paint from nonaluminum parts. Sizing of the systems and production capacities are based on operating practices at RRAD.

4.1 FBPS

4.1.1 Operational Data

Heating-bed temperatures must be in excess of 650°F to remove paint from metal parts in the FBPS. In this study and a parallel study conducted by USATHAMA at LEAD, such temperatures were found to cause aluminum to lose its temperature hardness (temper). Because it is impractical to incorporate a heat-treatment step to restore temper in the RRAD paint-removal operations, the FBPS is suitable for paint removal on nonaluminum alloy parts only, which are not affected by the FBPS operating temperatures.

Paint, rubber, plastic, oil, grease, and other organic coatings or residues are removed by the FBPS. Also, parts treated in the FBPS do not have to be cleaned in a vapor degreaser before treatment.

Some safety concerns are associated with the use of a high-temperature pyrolysis treatment system. These include burn hazards and the control of toxic off-gases (e.g., carbon monoxide, nitrogen oxides, and formaldehyde). Engineering controls, safeguards, and monitoring are required to minimize worker exposures.

4.1.2 Waste Generation

Metals present in paints, coatings, and electroplates will accumulate in the FBPS media. Organics are destroyed through pyrolysis or are volatilized in the hot bed and destroyed in the afterburner. Although not confirmed by testing during the program at RRAD, it is assumed that this accumulation of metals will eventually impart the characteristic of RCRA toxicity to the media and cause it to be regulated as a RCRA hazardous waste. The companion FBPS project conducted at LEAD demonstrated that the media became contaminated with lead and was RCRA hazardous (by TCLP testing) after only three runs. During the LEAD study, testing was conducted with large loads of parts coated with lead-based paints. Because lead-based paints are still relatively common in coatings stripped at RRAD, it is anticipated that spent FBPS media will be classified as a hazardous waste. The manufacturer recommends a biannual bed change-out, which would generate about 4000 lb of hazardous waste per year. Based on information obtained during the LEAD study, about 3 lb of contaminated media per hour of operation would be lost through carryover, dragout, and fugitive dust. This represented a more significant waste stream than that produced by bed change-out. Operations of the FBPS at RRAD, however, included methods to collect carryover and dragout and return it to the fluid bed, which eliminated this potential waste.

4.1.3 Capital and Annual Costs

The estimated installed capital cost of the FBPS ($512,000) reflects the actual installed cost of the demonstration unit at RRAD.

Table 4-1 presents estimated annual costs of the FBPS. Treatment of a road arm (Part No. 8756363) was used as the basis for costs. A production rate of 250 parts per week was used as the basis for calculation; this rate was based on observation and best engineering judgment. The per-part cost of $9.51 for the FBPS reflects RRAD operations and could differ at other locations.

TABLE 4-1. ANNUAL COSTS OF THE FBPS
(1991 dollars)

Item	Cost
Labor	
Operating labor, 2080 h at $20/h	41,600
Maintenance labor, 150 h at $20/h	3,000
Total	**44,600**
Raw Materials	
Aluminum oxide makeup, 0.5 lb/h at $1.20/lb	1,250
Aluminum oxide change-out, every 2 years	2,500
Spare parts, 1 percent of capital cost	5,120
Total	**8,870**
Utilities	
Electricity, average of 37 kWh, at 4.2¢/h, 2080 h	3,230
Water, 250 gal/h at 0.46/1000 gal, 2080 h	230
Natural gas for incinerator, 0.2 million Btu/h at $3/h, 2080 h	1,250
Total	**4,710**
Waste Disposal and Treatment	
Water, 250 gal/h at 0.46/1000 gal, 2080 h	230
Aluminum oxide made up and changed at 1.5 lb/h at 45¢/h, 2080 h	1,400
Paint char disposal, 20,000 ft^2 of 10 mil coating, 100 lb/ft^3, 50 percent to char at 45¢/lb	380
Total	**2,010**
Capital Recovery[a]	
15 years, 9 percent interest ($512,000 x 0.12394)	63,460
TOTAL ANNUAL COST	**123,650**
250 road arms per week, 52 weeks = 13,000 road arms	
COST PER ROAD ARM	**9.51**

[a] Based on methods contained in Grant, E. L., and W. G. Iresor. Principles of Engineering Economics. Fifth Edition. Ronald Press Co., New York, 1970.

4.2 Aqueous Caustic Paint-Stripping Systems

4.2.1 Operational Data

Parts treated by caustic stripping must first undergo vapor degreasing. Any rubber or plastic must be removed from the parts.

Past operational practices at RRAD incorporated corrosion removal with caustic stripping. This was accomplished by mixing the corrosion-removal chemicals with the caustic paint stripper, which allowed corrosion and paint to be removed in one operation. Current operations use separate tanks for these solutions.

The caustic stripper system involves no unique safety requirements other than those normally in place during the handling of heated corrosive liquids.

4.2.2 Waste Generation

Because contaminants gradually build up in the caustic solution and impede its effectiveness, the solution must be periodically disposed of and replaced with fresh solution. Caustic stripping at RRAD generates both liquids and sludges that are classified as RCRA hazardous waste. Other waste streams generated by the caustic stripping process include overflow from the rinse tank, which is discharged to the onsite industrial waste treatment plant (IWTP), and spent TCA and vapor degreasing residues, which are disposed of offsite as hazardous waste.

4.2.3 Capital and Annual Costs

Table 4-2 shows the breakdown and total capital cost of the caustic paint-stripping system at RRAD. As shown, the total capital cost for this system is $173,700.

TABLE 4-2. CAPITAL COSTS OF THE AQUEOUS CAUSTIC PAINT-STRIPPING SYSTEM (1991 dollars)

System	Component cost	Total cost
Caustic paint-stripping system		173,700
Stainless steel solvent degreasing tank	134,500[a]	
Carbon steel paint-stripping tank	19,200[a]	
Hoist and crane	10,000[b]	
Carbon steel water rinse tank	10,000[c]	

[a] Vendor-supplied information.

[b] Installed cost of test system.

[c] Peters and Timmerhaus.

Table 4-3 presents the estimated annual costs of the aqueous caustic paint-stripping system. The production rate used in this calculation was 750 parts per week, based on observation and best engineering judgment. The estimated cost per part is $4.11.

4.3 Comparison of the Two Systems

As indicated in the preceding discussions, the cost of the FBPS is more than twice that of the caustic stripping system, and it has only about 30 percent of the production capacity. Matching the production capacity of a solvent-based system would require either the purchase of a second FBPS or the operation of one unit on a multi-shift basis. The latter would be the less costly option. Adding a second shift would double all the operating costs in Table 4-1 except the capital recovery factor and result in a total cost of $183,840 per year. Based on processing 13,000 parts per year per shift, the operating cost per part would be about $7.10.

Another noteworthy difference in the two systems involves safety. The FBPS poses some safety concerns that would have to be minimized through engineered controls, safeguards, and monitoring. The caustic stripping system, on the other hand, involves no unique safety requirements other than those normally in place during the handling of heated corrosive liquids.

The difference in waste generation is of primary interest. Wastes are generated in the form of accumulated metals in the media of the FBPS system. This spent media waste is expected to be regulated as RCRA hazardous waste. In the caustic stripping system, contaminants build up in the caustic solution and impede its effectiveness. This solution and associated sludges must be disposed of and replaced with fresh solution. At RRAD, both liquids and sludges that are classified as RCRA hazardous waste are generated. Other hazardous wastes generated by the caustic stripping system that must be disposed of offsite include spent TCA and vapor degreasing residues.

TABLE 4-3. ANNUAL COSTS OF THE AQUEOUS CAUSTIC SOLVENT-BASED PAINT-STRIPPING SYSTEM (1991 dollars)

Item	Cost
Labor	
Operating labor, 4160 h at $20/h	83,200
Maintenance labor, 150 h at $20/h	3,000
Total	**86,200**
Raw Materials	
Biannual replacement of paint stripper, 2500 gal at 60¢/gal	1,500
Caustic makeup, 200 lb/day, 7¢/lb, 260 days	3,640
Trichloroethane losses, 5 gal/day, 260 days at $6.02/gal	7,830
Spare parts, 1 percent of capital cost	1,740
Total	**14,710**
Utilities	
Electricity, 25 kW, 2080 h at 4.2¢/kWh	2,180
Chilled water for degreaser coils, 1000 gal/h at $3/1000 gal, 2080 h	6,240
Steam, 500 lb/h at $3/1000 lb, 2080 h	3,120
Rinse water, 1000 gal/h at $0.46/1000 gal, 2080 h	960
Total	**12,500**
Waste Disposal and Treatment	
Degreaser sludge disposal, 5 gal/day, 260 days, 11 lb/gal, 45¢/lb	6,440
Water, 2000 gal/h at 46¢/1000 gal, 2080 h	1,910
Spent stripper disposal, biannual replacement, 2500 gal, 9 lb/gal, 45¢/lb	10,130
Paint sludge, 60,000 ft^2 of 10-mil coating, 100 lb/ft^3, 1/3 paint, 2/3 water and solvent	6,750
Total	**25,230**
Capital Recovery[a]	
15 years, 9 percent interest ($173,700 x 0.12394)	21,530
TOTAL ANNUAL COST	**160,170**
750 Road arms per week, 52 weeks = 39,000 road arms	
COST PER ROAD ARM	**4.11**

[a] Based on methods contained in Grant, E. L., and W. G. Iresor. Principles of Engineering Economics. Fifth Edition. Ronald Press Co., New York, 1970.

SECTION 5

CONCLUSIONS

The FBPS is not a suitable replacement for the chlorinated solvent stripping systems currently used to remove paint from aluminum and aluminum alloy parts at RRAD. When exposed to 700 to 800°F temperatures for the 1-h residence time required to pyrolize paint, aluminum parts lost essentially all of their hardness (temper). To use the FBPS to treat aluminum parts would require the addition of a heat-treatment step, which would be impractical.

In most cases, the FBPS can remove paint from nonaluminum and non-heat-sensitive parts without affecting the temper or causing warpage or shape distortion; however, some parts (such as thin vent covers) may be warped. Although degreasing is not required before treatment, the cost of using FBPS is significantly higher than the cost of using the caustic stripper system. Costs per part for the FBPS treatment are 70 to 130 percent higher, depending on the number of shifts the system is operated. Because not all nonaluminum non-heat-sensitive parts can be processed in the FBPS, it cannot be used to eliminate caustic stripping. This treatment would not be suitable for parts with crevices, channels, or cavities that would retain FBPS media and be difficult to clean afterward (e.g., engine blocks).

Metals present in the paints and coatings stripped from parts treated in the FBPS accumulate in the bed media. These metals would likely cause the bed material to be a RCRA-characteristic hazardous waste because of toxicity. Because media dragout and dusts were captured and recycled, the volume of this waste was estimated to be much less in this system than in the FBPS tested at LEAD. The FBPS generates less waste on a per-part basis; therefore, the overall amount of waste generated would be reduced regardless of the percentage of the parts treated in the FBPS. Air

emissions were adequately controlled by the system and were within the constraints of the State permit. Scrubber water retained some of the metals, but it was still acceptable for treatment in the onsite IWTP.

Because these conclusions are based on testing conducted under controlled conditions and noncontinuous operation, they should be verified by further analysis.

APPENDIX A

DESCRIPTION OF RED RIVER ARMY DEPOT ACTIVITIES

APPENDIX A

DESCRIPTION OF RED RIVER ARMY DEPOT ACTIVITIES

In addition to being a repository for weapons and ammunitions, RRAD has multiple other missions. A primary mission is the maintenance of selected military vehicles. This maintenance activity is the subject of this summary. The maintenance responsibility at the Depot varies, depending on military vehicles being used in the field. Principally, RRAD is responsible for maintaining 2- to 10-ton trucks, trailers, 113-type armored personnel carriers (M577 Armored Command Post, M106 Self-Propelled Mortar, M741 Vulcan Weapons Carrier, M730 Chaparral Missile Carrier, etc.), and Bradley tanks. It also performs some maintenance on pickup trucks and other types of vehicles. Figure A-1 is a photograph of a typical truck processed at RRAD.

The Depot operates several types of programs for military vehicles, including inspection and repair programs, complete tear-down/rebuild programs, engine stocking programs, etc. These programs can be subdivided by the following activities: component tear-down, component cleaning, component rebuild, assembly, and stocking.

Vehicles received at RRAD are stored outside in large lots. When orders are received regarding which vehicles are to be repaired, the fuel is drained from these vehicles and they are moved into the disassembly area.

In the disassembly area, the large, heavy, track components and some of the exterior armament components are removed from the vehicle. It is then moved to a separate disassembly area, where the engines, transmissions, and remaining interior components are removed. When the vehicle has been stripped down to the hull, it is steam-washed. The remaining components are shipped either to further disassembly

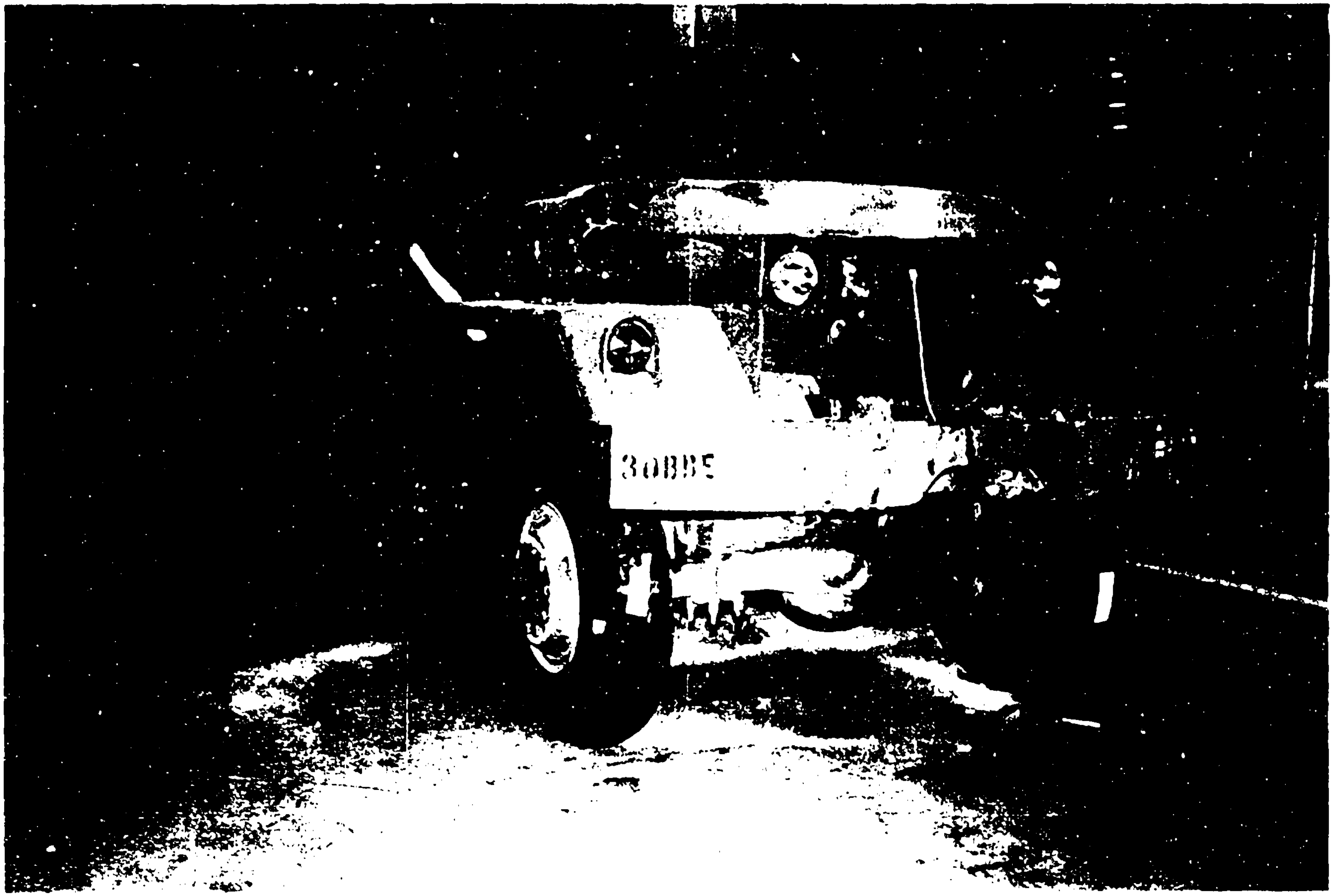

Figure A-1. Typical truck processed at RRAD.

areas or to disposal/salvage. Some components are only partially disassembled and others are completely disassembled before cleaning. For example, the engines are moved to an engine disassembly area, where they are completely dismantled.

The amount of disassembly done on the vehicle depends on whether it is a complete tear-down/rebuild candidate or is scheduled for inspection and repair. The Depot's missions change as the requirements of the military commands change.

Inspection and repair (I&R) are common programs at RRAD. In the I&R programs, the vehicle is only disassembled to the point required for inspection and repair. This program typically involves removal of such items as engines, transmissions, and tracks; it usually does not include all the internal and external components.

There are several variations of the basic Bradley tank and the M113 vehicles (the two vehicle types from which parts were selected for evaluation in the FBPS). The two basic variations in the Bradley (A-1 and A-2) differ primarily in engine size and armament. Several of the other variations deal with the housing configuration (locations of holes, exhaust ports, and other minor differences). Figure A-2 shows a schematic side view of a complete Bradley.

The Type-113 vehicle includes a more extensive number of variations--12 basic variations and several minor variations. Figure A-3 shows the 12 basic vehicle types in the 113 family of vehicles, and Figure A-4 shows a schematic side view of a complete 113 Tracked Armored Personnel Carrier. Each of these different vehicles carries different identification name plates, but all are similar with regard to engines, transmissions, and basic running gear and chassis design.

The Depot is divided into several specific areas for cleaning and repair, including Buildings 333, 345, 348, and the Body Shop. Each of these buildings has numerous processing areas. Building 345, for example, contains several cleaning shops, welding shop areas, disassembly and repair areas, transmission and hydraulic repair areas, a plating shop, machine shops, and various office areas.

When the vehicles are released for repair, they are taken to Building 345, first floor (345-1), Row 1, Column W, where the tracks and the largest parts are removed.

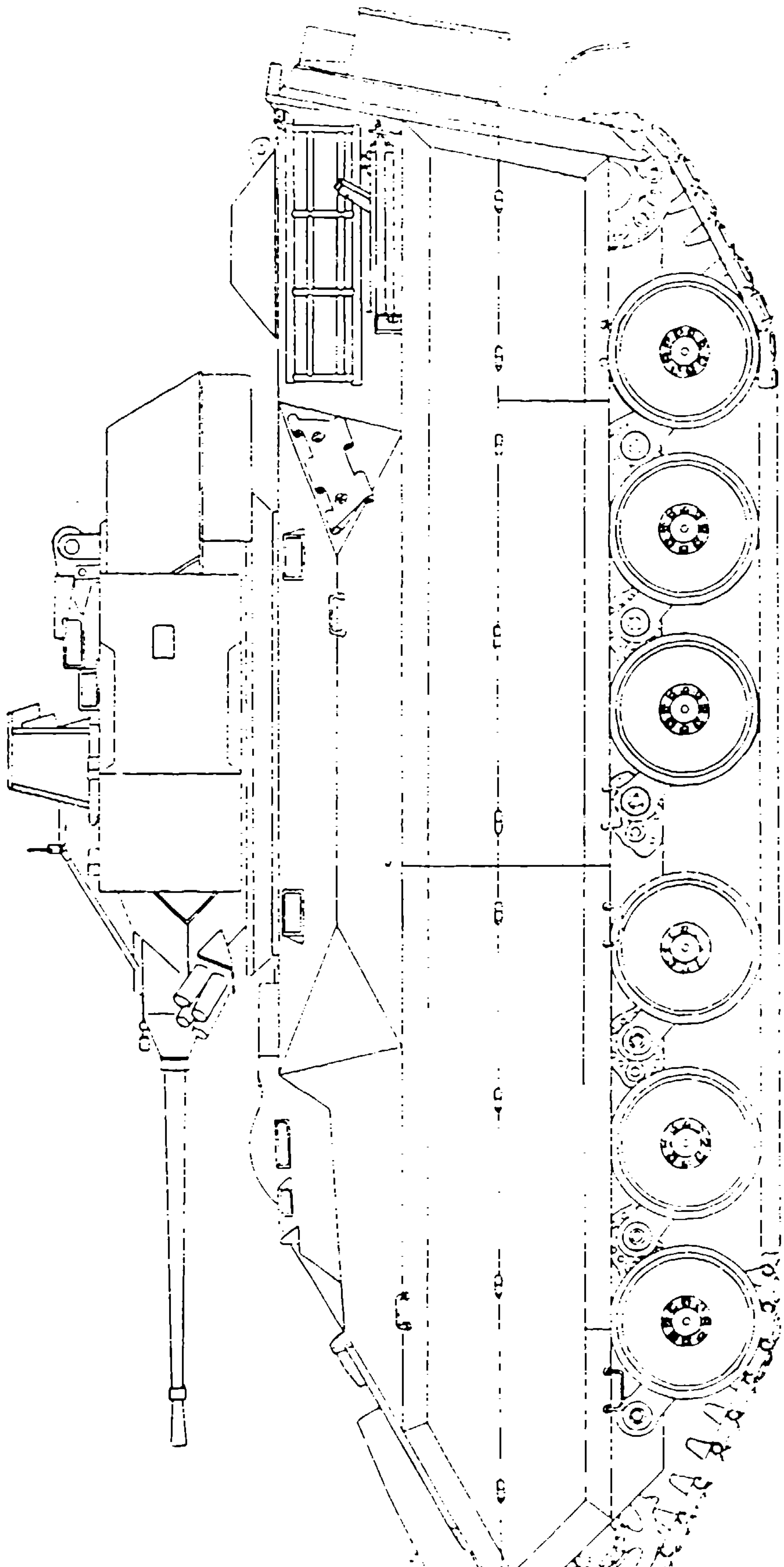

Figure A-2. Bradley fight vehicle.

Figure A-3. M113A2 family

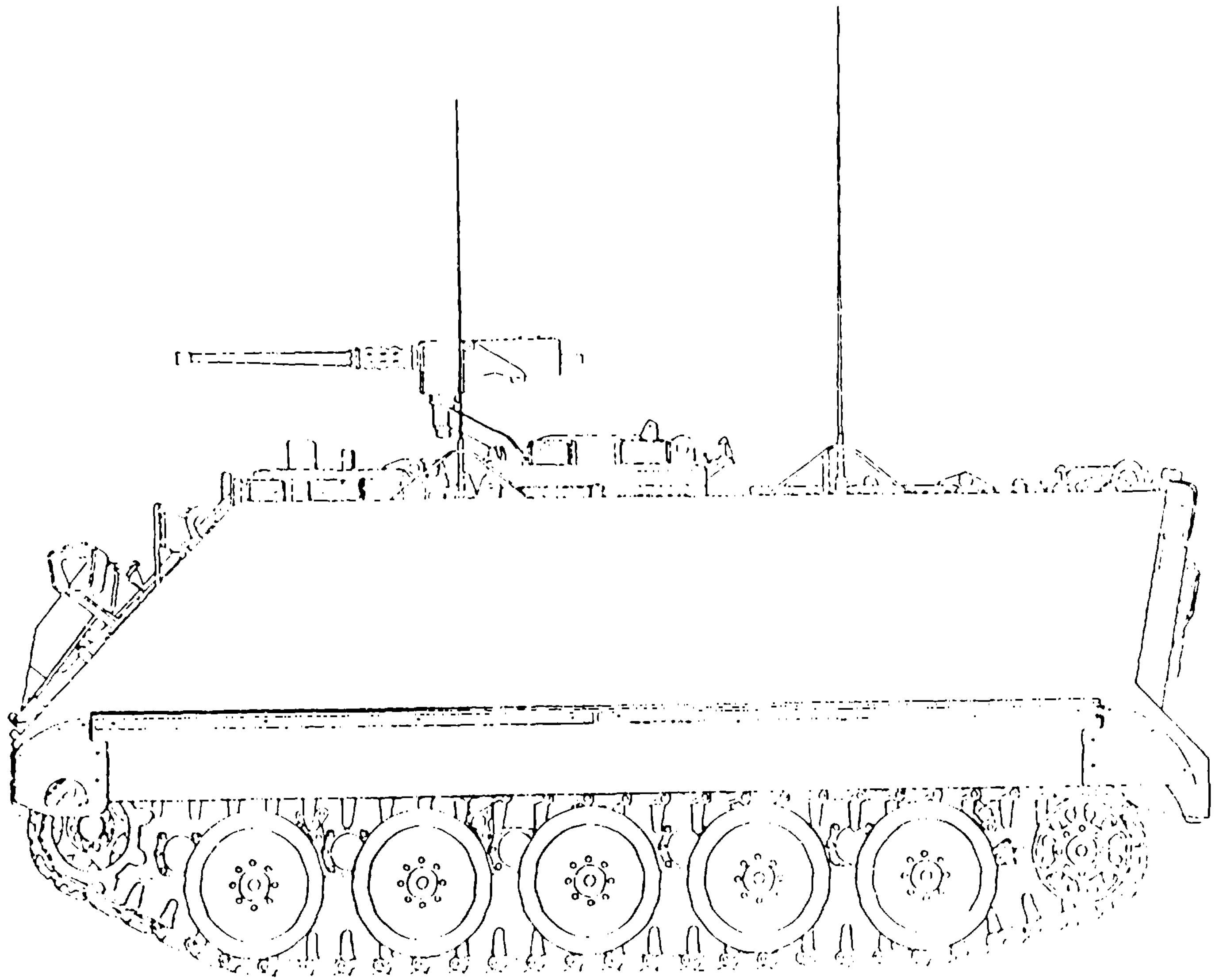

Figure A-4. 113 Tracked Armored Personnel Carrier.

Figure A-5 shows a schematic of a Bradley tank, and Figure A-6 is a photograph of an actual Bradley tank with the side armor removed in this area.

After the parts removal in Building 345, the vehicles are moved either to temporary storage or to Building 333. In Building 333, the vehicle is first taken to the hull disassembly area, where the remaining parts are removed and placed in pallets. Figure A-7 is a photograph of a vehicle being disassembled in this area.

At this disassembly area, parts are broken down into several categories: those requiring further disassembly, those to be cleaned, and those intended for salvage. Some of the parts sent to cleaning are not fully disassembled. Parts to be cleaned are distributed to the following areas: Body shop, Building 345 wash rack, sand blasting, Building 348 wash rack, or Building 345 Line 10. Some parts are cleaned and then disassembled further; some are cleaned and then worked on as assemblies. The degree of disassembly and whether the part is cleaned before further disassembly depends on the workload as well as the specific configuration of the parts. Those determinations are typically made by the Depot and are subject to change depending upon the processing capabilities at the time the parts are processed.

The cleaning activities at RRAD are divided into the following general categories: washing, abrasive cleaning, degreasing, chemical cleaning, and manual cleaning with various brushes and other mechanical methods. Washing includes steam cleaning, soap-and-water wash, and water blast. Abrasive cleaning includes walnut hull, silica sand, stainless steel shot, aluminum oxide grit, glass bead, etc. Those operations are carried out in automated blast cabinets (for things such as the vehicle hulls), in small hand cabinets (for some smaller components), in larger fully enclosed cabinets (for larger parts), or in rotoblast type equipment. Degreasing involves the use of such components as 1,1,1-trichloroethane vapor degreasing and other degreasing agents (e.g., Stoddard solvent). Chemical cleaning includes various paint-stripping agents, such as methylene chloride and caustics, as well as various rust-removal and corrosion-removal components.

Parts considered to be candidates for the fluidized-bed paint stripper were found in various cleaning and disassembly areas. During repair programs, vehicles of

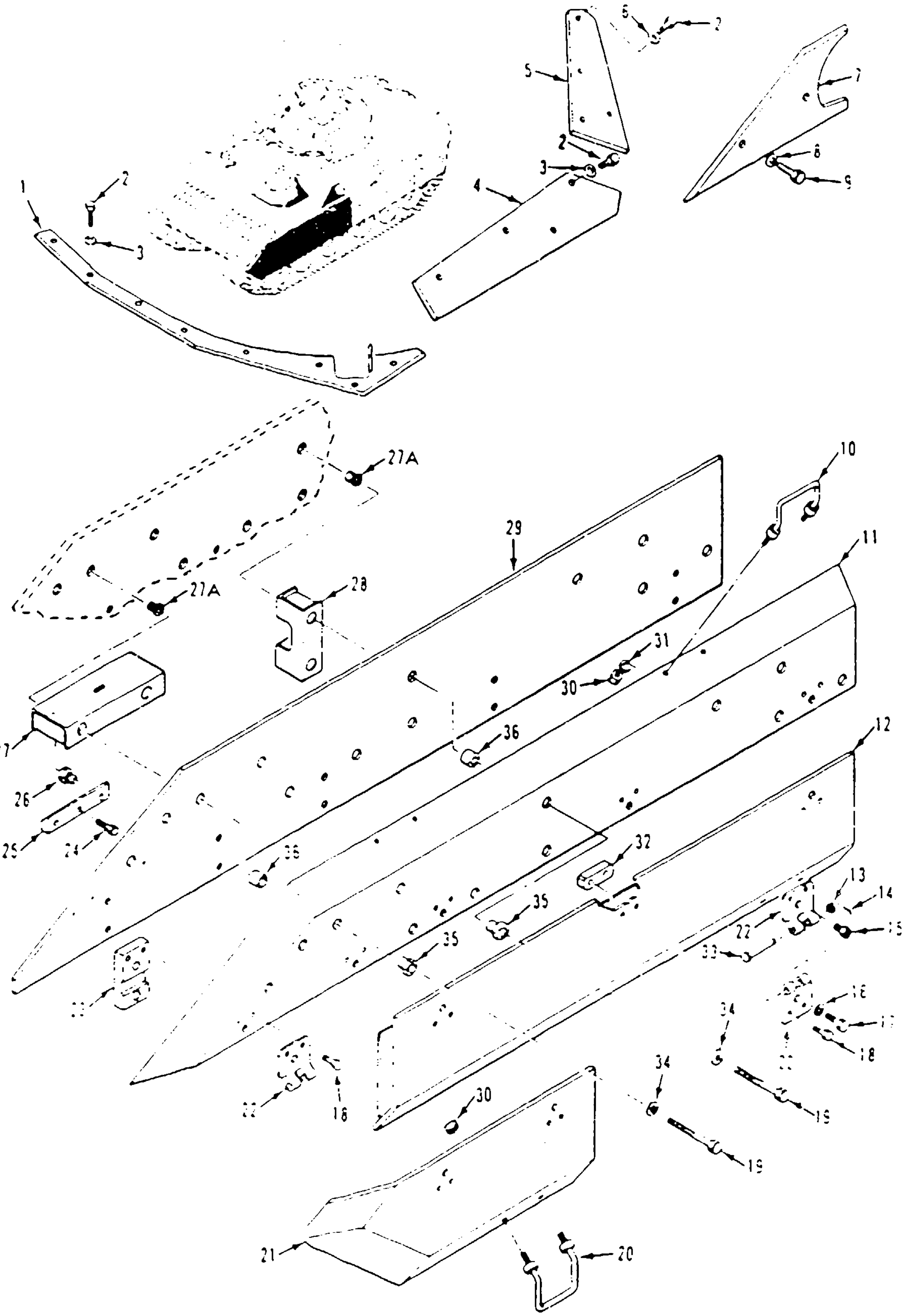

Figure A-5. Bradley left side bolt on armor.

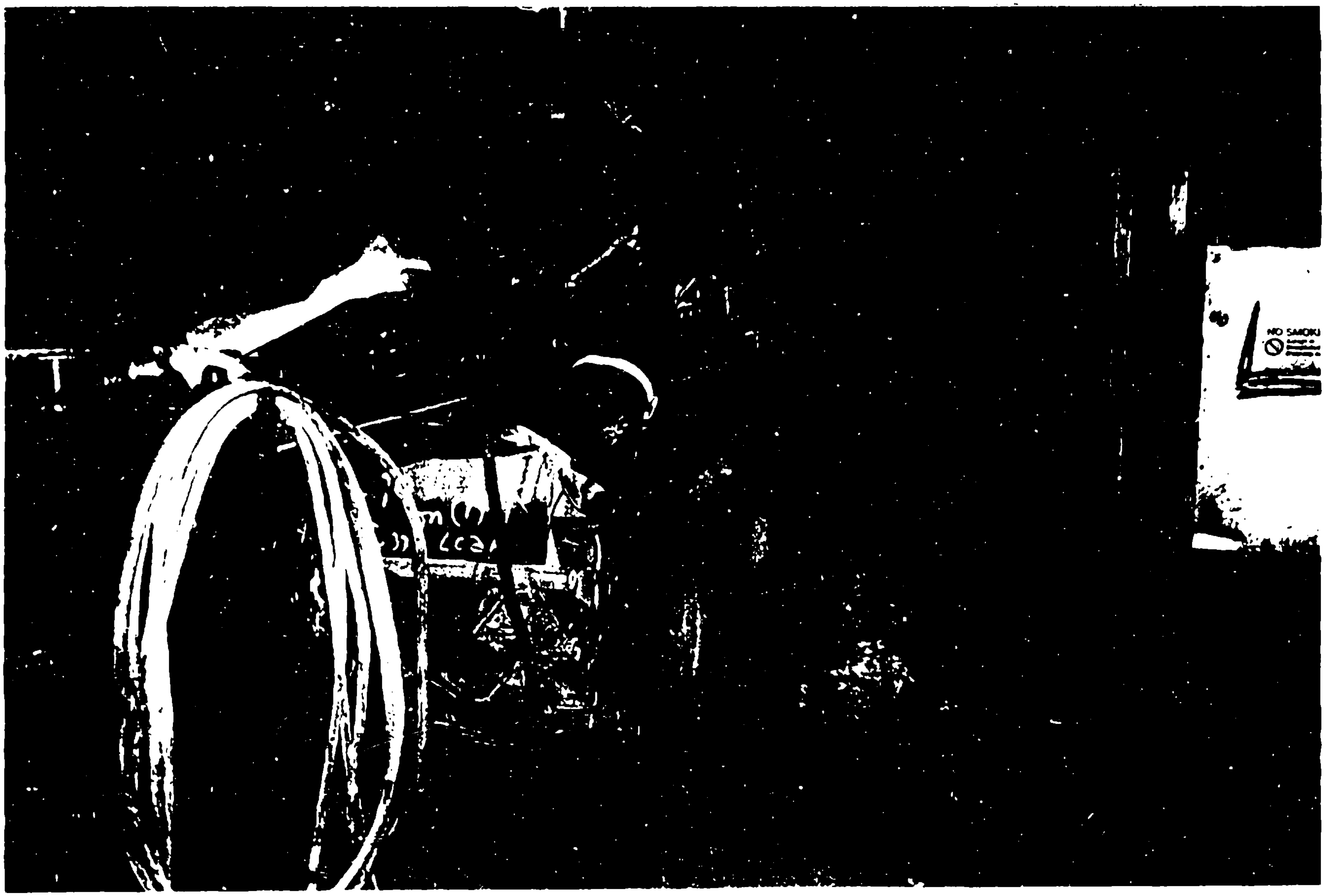

Figure A-6. Photograph of Bradley showing side armor being removed.

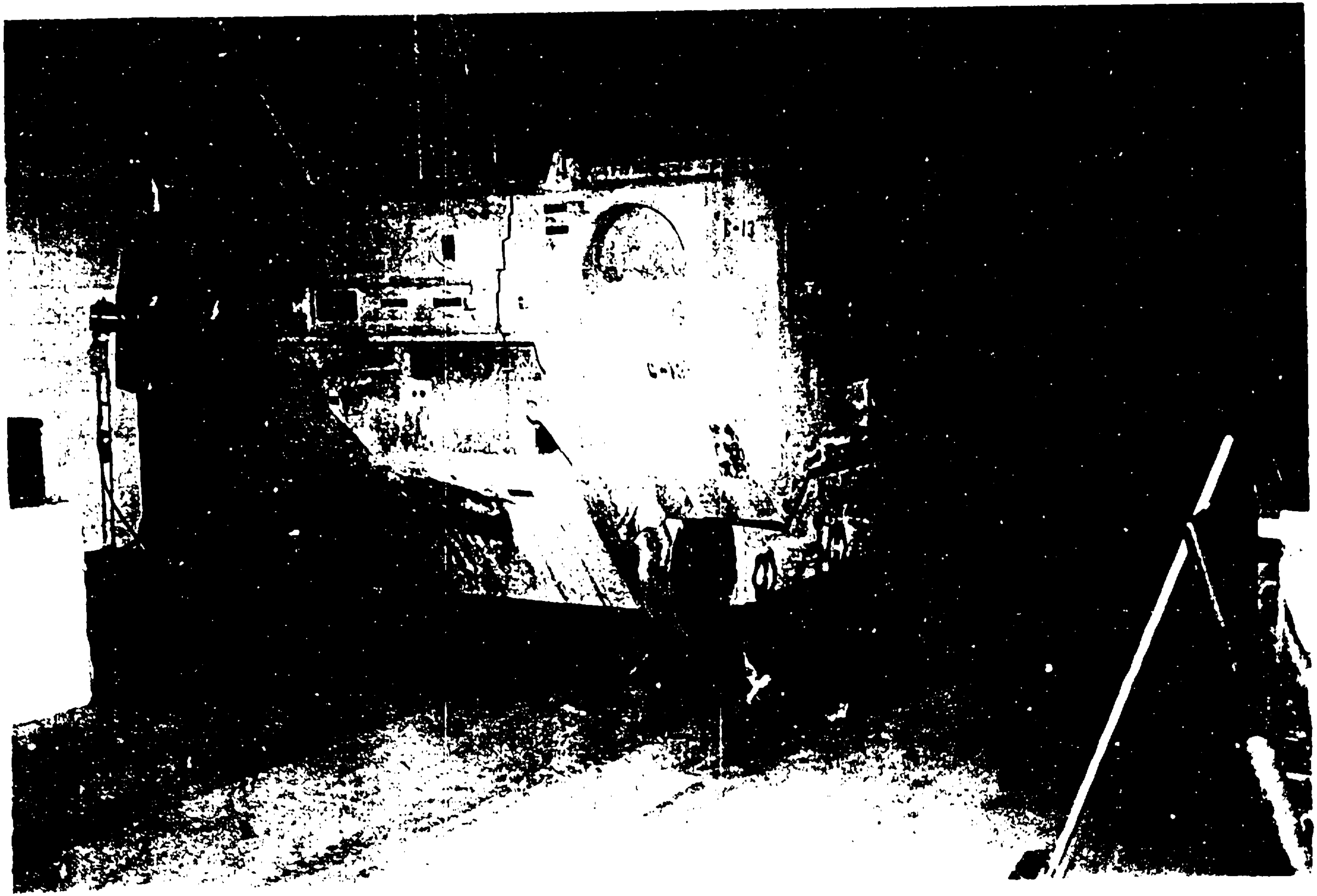

Figure A-7. Photograph of 113 type vehicle in Building 333 after complete removal of all components before cleaning.

a specific type are accumulated and all vehicles of that particular type are processed together. This produces specific collections of parts for cleaning and rebuilding at different times within the Depot. Typical campaigns can last from a few weeks to years, and different campaigns can be ongoing simultaneously in different parts of the Depot. Therefore, different collections of parts were available at different times for evaluation in the FBPS.

The three major cleaning areas from which parts were taken are Building 348 (although RRAD discontinued use of this building shortly after all field data were taken, it was active during the testing and a discussion of activities in that building is still relevant to this report); Building 345, first floor (North Wash Rack); and Building 345, second floor. Each of these areas had several cleaning lines.

The various cleaning processes affected by the FBPS in each area can be divided into three general categories: degreasing, aluminum or nonferrous cleaning, and ferrous cleaning. Early in the evaluation of the FBPS, aluminum parts were eliminated as candidates for processing in the FBPS because the operating temperatures removed temper from aluminum parts and all aluminum parts investigated at RRAD were so treated or conditioned. Therefore, only the ferrous cleaning operations are affected by operation of the FBPS. Current processing at RRAD includes corrosion-removal and paint-stripping operations. Inasmuch as FBPS does not remove corrosion, chemical corrosion treatment is still required on many FBPS candidate parts. Thus, the current chemical cleaning operations would have to be modified if the FBPS were used. Such modifications are the subject of other ongoing studies at RRAD and other depots and are not addressed in this report.

APPENDIX B

TEST PLAN FOR EVALUATING THE PROCEDYNE FLUIDIZED-BED PAINT STRIPPER AT RED RIVER ARMY DEPOT

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TEST PLAN FOR EVALUATING THE PROCEDYNE FLUIDIZED-BED PAINT STRIPPER AT RED RIVER ARMY DEPOT

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PN 3769-5

Prepared for
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Aberdeen Proving Grounds
Baltimore, Maryland

April 1990

Revision No. 0
Section No. ______
Page ______ of ___.
Date May 5, 1990

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CONTENTS (continued)

TABLES

FIGURES

PREAMBLE

This test plan is a numbered, controlled circulation document. It is intended that periodic updates will be developed and issued to the Plan Holders. The updates will be replacement/additional pages. Each Plan Holder (listed below) is responsible for maintaining his plan current. If there are any questions or comments direct them to the Project Manager.

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6.	Project Manager	PEI

Revision History

Revision	Item	Date
0	Initial Issue of Test Plan	May 5, 1990

SECTION I. INTRODUCTION

This test plan provides specific information on parts processed in the fluidized bed paint stripper (FBPS) at the Red River Army Depot (RRAD) will be evaluated. Included is a brief introduction on how the fluidized bed works, a discussion of the test objectives, and specific test procedures and methodologies. The U.S. Army Toxic and Hazardous Material Agency (USATHAMA), through its contractor, PEI Associates, will purchase and install a Procedyne Corporation FBPS at the RRAD. The FBPS is a production unit used to remove paint, oils, and greases from metal parts by immersing the parts in a fluidized bed of aluminum oxide granules maintained at temperatures high enough to pyrolyze organic matter. Typical temperatures range from 700 to 1,000°F with residence times in the bed of approximately one hour. Usually there is insufficient oxygen in the bed to support combustion. Therefore, organic matter on the parts and in the coatings (paints and primers) are pyrolyzed in the FBPS to carbon and carbon monoxide. An inline gas-fired incinerator burns the carbon monoxide and fluidizing bed gases. The products of combustion are exhausted through a water venturi scrubber to the atmosphere.

During the pyrolization, the binders (organic compounds) in the paints and primers are destroyed. Once the binders are destroyed, the part is left coated with a loosely adhering char composed of carbon and inorganic paint pigments. Plans are to remove the char using a low-energy shotblaster or other removal techniques, thus, leaving the part ready for recoating.

The FBPS is an alternative to solvent-based paint stripping systems. Solvent-based paint stripping systems typically use methylene chloride and other chlorinated solvents. The solvents

chemically destroy the organic binders in the paint. Once destroyed, the remaining coating material is removed with washing action or shotblasting before recoating.

Typically, chemical paint stripping solvents are toxic and volatile. Methylene chloride, the most commonly used solvent, is especially volatile (boiling point 40°C or 104°F). The chemical paint stripping process generates sludge. The sludge consists of stripped coatings contaminated with paint stripper solvents. The sludge is listed as a categorical hazardous waste and must be disposed of as such. PEI and USATHAMA believe that installation of the FBPS will reduce atmospheric releases of stripper compounds (mostly chlorinated solvents) and reduce the volume of hazardous wastes requiring disposal. Therefore, the objective of this test program is to demonstrate that the use of a FBPS will reduce hazardous waste while satisfactorily removing coatings (or assisting removal) and facilitate reuse of parts at the RRAD.

A FBPS is an alternative to chemical paint stripping. However, the FBPS uses high temperatures that may affect the parts (temper, hardness, metallurgy, physical dimensions etc.). Therefore, this project must, besides determining the FBPS's usefulness as a hazardous waste minimization process, determine which parts can be processed in the FBPS and the appropriate processing steps and conditions. This test plan defines how this will be done.

The test plan is divided into sections. Section II discusses the objectives of the test plan. Section III discusses the test parameters. Section IV describes the methods of parts categorization, procedures for determining if processing should be attempted, and a part's ranking system that allows processing of the most likely candidate parts first. Section IV also includes several decision trees that describe how the categorizing and ranking are done. Section V presents the forms used to record parts data on the evaluated parts. Section VI describes

pre-operational testing planned for selected parts. The pre-operational testing provides more detailed data used to revise the test plan before the actual operational testing in the demonstration bed. Section VII discusses operational test data and the how the data will be used in the operational demonstration testing. Section VIII discusses the operational tests. Section IX discusses how data is evaluated. Section X describes sections of the report prepared after completion of the testing.

The test plan is a fluid document that will be revised as the testing progresses. The test plan will be maintained in a loose-leaf binder and periodically updated. Distribution of the document is controlled and each copy numbered and assigned to a specific user. Updates will be issued on an as needed basis to the plan holders. The plan holders will be responsible for replacing the revised pages and removing and discarding replaced pages. Each page will be identified by revision number, section, page number, and revision date. A revision history is included in the Preamble.

SECTION II. OBJECTIVES OF THE TEST PLAN

The FBPS testing has five objectives:

- Find appropriate FBPS operating conditions for various parts/coating systems.
- Establish the effect of the FBPS on the cleaned parts.
- Prepare a technical report on the appropriate uses of the FBPS.
- Train RRAD personnel to operate and maintain the FBPS.
- Determine the FBPS effect on waste generation at RRAD.

This section of the test plan outlines how the testing procedures will be used to meet the objectives. Processed parts will be identified and data on their "before" and "after" conditions recorded. Satisfactory demonstration of the FBPS operation may require additional processing (for example, parts may require secondary cleaning in a low-energy shotblaster). Also, parts may require additional processing, such as heat treating, chemical washing, coating treatments, etc. Once cleaned, parts will be reconditioned, pending satisfactory evaluation, and placed back in service. No part will be placed in service until the project manager determines that the FBPS did not adversely affect the part.

Parts will be evaluated in a step-wise fashion. For example, the condition of parts before the FBPS, after the FBPS, after secondary cleaning, after intermediate treating, after final recoating/reconditioning. Such a step-wise evaluation process will simplify evaluations and be more effective in the management of available resources.

A. Define FBPS Operating Conditions

Three areas define the FBPS operation; the coatings and parts; the bed conditions; and pre- and post-part treatments. Each operating area has a unique set of evaluation criteria. By examining each area separately, the process of understanding the operating parameters is simplified.

1. Coatings and Parts

Current operating experience is limited. This task will eventually define what can be processed. Now, data are insufficient to define operating conditions. The coatings allowed in the FBPS have two components: organics (paint organics, oils, greases, binders) and inorganics (paint solids, paint fillers, cadmium, zinc, electroless nickel, electroplates, aluminum anodizing, etc.). The more common paints and primers that will be processed in the FBPS are:

- MIL-C-22750 Coating, Epoxy-Polyamide
- MIL-C-46168 Coating, Aliphatic Polyurethane, Chemical Agent Resistant
- MIL-P-53022 Primer, Epoxy Coating, Corrosion Inhibitant, Lead and Chromate Free
- MIL-C-53039 Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant

The greases and oils are lubricants. Some parts have cadmium or zinc electroplates. The 700-1,000°F operating temperatures are above the melting point of cadmium and can be above zinc's melting point.

The FBPS bed temperature is expected to remove cadmium electroplates. The cadmium will oxidize to cadmium oxide in the FBPS. Zinc metal melts at 419.6°C (787°F) and may be removed in the FBPS depending on the bed operating conditions. The zinc either converts to oxides and exits the bed as char or an air

contaminant, or liquefies and remains in the bed on cooler bed parts until physically removed. Part of the test program is to determine the fate of zinc and cadmium electroplates in the bed. These and other heavy metals are potentially damaging to the environment and require special attention before processing. Most of the other inorganic coatings (including paint inorganics) will not be removed in the FBPS. For example, chromium and nickel electroplates, anodized aluminum coatings, aluminum chromate conversion coatings, and zinc phosphate steel coatings should be unaffected by the FBPS.

Evaluation of the parts is necessary since the project objectives include verification of the effect of the FBPS on the inorganic coatings. Normal processing requires dimensional checking of hard chrome and nickel plated parts (mostly bearings). This information is also used to verify dimensional stability after cleaning. These surfaces are replated, if necessary, after cleaning to restore them dimensionally. Other cleaning processes typically remove the other coatings as part of the reconditioning process. While heating may weaken these coatings through thermal stress, differential expansion between the base metal and plating, and phase changes, the FBPS will not appreciably remove them.

Thousands of parts are possibly processed at RRAD. The testing will identify the various metal parts. Metal parts processed in the FBPS are possibly aluminum alloys (5083, 5086, and 6061), aluminum castings (355 or 356), carbon steel, cast iron, and possibly stainless steel. Metals processed frequently received tempering treatments such as H32, H111, H321, T4, T6, and T823. The testing includes assessment of the effect of the FBPS on temper. The test program includes testing to restore temper, if necessary, and includes in the project recommendations operating procedures to restore temper.

Specific types of parts must be excluded from the FBPS. For examine, polyvinyl chloride (PVC) and other plastics cannot withstand the operating temperatures of the FBPS. Under the bed conditions, these components will burn/pyrolyze and be destroyed. Additionally, because of their high organic content, they can produce more pyrolysis products than the system can handle and atmospheric emissions not permitted for the system. Parts containing plastics, such as Part Number 11634072, Cover, Insulated, cannot be processed in the FBPS. Parts with solder connections should not be processed in the FBPS since the solder will melt, destroy the connections, and possibly cause unpermitted emissions. Parts having components that would be destroyed at the FBPS operating temperatures should not be processed in the FBPS.

This test plan proposes to use shotblasting to remove the char residue from parts after pyrolysis in the FBPS. Therefore, parts that cannot be shotblasted may be unsuitable for cleaning in the FBPS. For example, Part Number 11010703, Scoop Disc Subassembly (an aluminum casting); the specifications prohibit shotblasting the part. Similar restrictions may make other parts unsuitable candidates for processing in the FBPS unless the use of low energy shotblasting or other cleaning techniques are acceptable alternative cleaning systems. Special consideration of steel shot cleaning is required for cleaning of aluminum parts to prevent steel contamination of the aluminum parts.

Magnesium parts cannot withstand bed operating temperatures. Bed conditions could cause magnesium parts to ignite and cause significant damage to the system through fire or explosion.

2. Bed Conditions

The bed conditions are complex and the testing will investigate only four bed variables:

1. bed atmosphere,
2. part geometry,

3. bed temperature, and
4. bed residence time.

Testing will review other bed conditions but not thoroughly investigate them; these include:

1. Cooling rates
2. Cooling medium (sand, water, air, etc.)
3. Heat transfer medium
4. Long-term bed effects (greater than three months of operation)
5. Multiple cycles through the bed
6. Synergistic effects of mixtures of various coatings and base metals and of simultaneously and sequentially processed parts.

Normally the bed atmosphere is reducing, using compressed air for fluidization. Combustible materials will only partially burn in the bed. If possible the testing will investigate the effects of a nitrogen atmosphere on various part parameters. Also, steam and argon may be investigated as fluidizing media to understand how changes in the bed atmosphere affect the various parts. Primary investigations will be with atmospheric air, and all other atmospheres will be judged in relationship to the primary operating conditions. The plan will not attempt to vary fluidization rates; manufacturers recommendations will be followed.

Bed temperatures can be varied from ambient to 1,000°F. The testing will experimentally set bed temperatures. Initially the bed temperatures are estimated to vary from 700-900°F with a nominal temperature of 750°F. The testing will determine the effect of bed temperature on the part/coating system and the optimum system cycle time.

Residence time and bed temperature are closely related; the testing will investigate both. A typical bed residence time is 30 minutes at 650°F for an acrylic paint and up to two hours for a high solids chemical resistant epoxy paint system. Testing will determine optimum times for various paint/part systems based

on minimum residence time to produce a satisfactorily cleaned part. This includes the influence of downstream processes to remove char.

The FBPS will remove different coatings. These coatings will include:

1. Epoxy-Polyamide (MIL-C-227501),
2. Aliphatic Polyurethane (MIL-C-46168),
3. Epoxy Coating Primer, and
4. A second Aliphatic Polyurethane (MIL-C-53039).

Some coatings may be more difficult to remove and require adjusting the FBPS operating parameters to obtain satisfactory results.

The shape, type of metal, and arrangement of the parts in the FBPS may influence operating parameters. Evaluation of base metal and part geometry is dependent upon variables, such as:

- Time for a part to come to bed temperature. For example, a thin part may come to bed temperature faster than a thick part, such as a motor block, and require less time in the bed.

- Ratio of recessed areas to flat exposed surfaces. Coatings may be removed from a flat coated surface faster than form a recessed surface.

- Variations in base metal coating systems. For example, epoxy coatings may be removed from aluminum at a different rate than from steel.

Tempered and/or heat treated parts may not be suitable candidates for FBPS cleaning. This test plan describes testing before and after the FBPS to determine the effects of the FBPS on such parts. Varying operating conditions may minimize or eliminate damage to these parts.

3. Pre- and Post-Part Treatments

Included in this test plan are procedures for tracking and evaluating the effects on parts of pre- and post-treatments, the effect of these treatments on the operation of the FBPS, and on

the part's suitability for cleaning in the FBPS. Testing will collect data on current pre- and post-treatments and establish this as a base of comparison. Once a base of comparison is set for a part and coating system, the effect of varying the pre- and post-treatments will be investigated. The investigation will determine if such treatments have a beneficial effect. Beneficial effects are such things as better finished part quality, reduced energy usage, reduced generation of hazardous waste, reduced use of cleaning agents, reduced atmospheric emissions, etc.

B. Establish Incidental Effects of the FBPS on Coatings and Metals

The FBPS is not intended to remove or effect nickel and chromium electroplates, anodized aluminum coatings, aluminum chrome conversion coatings, zinc phosphate steel coatings, and metal heat treatments. Except hard chrome and nickel plated bearings, further processing removes and replaces these coatings. Testing identified in this test plan and done on plated bearings will determine the effects, if any, of the FBPS on the nickel and chromium electroplates.

Cleaning parts in the FBPS at 700 to 1,000°F may affect metal heat treatment and tempering. This plan establishes test procedures to determine the effects of the FBPS on heat treated parts.

C. Prepare a Technical Report on the Appropriate Uses of the FBPS

This test plan describes the what, why and how of testing. The test plan also describes how the information collected will be reported. The reporting serves to inform RRAD of the test results and will guide other Depots and potential users of the FBPS in establishing operating conditions. The technical report produced from this study will include details on the following:

1. Part description
2. Coating description
3. FBPS description
4. Emissions testing results
5. Parts/coatings evaluations
6. Recommendations

Results of the tests will be included in the technical report. Accepted quality control procedures will be followed in all testing and referenced in this test plan and report.

D. Train RRAD Operating and Maintenance Personnel

The FBPS will provide satisfactory service only if properly operated and maintained. While Procedyne Corporation, the equipment vendor, will provide most of the formal training, the test program will provide hands-on training and experience. The test program will provide an improved understanding of the selection of proper operating parameters and parts that must be kept out of the system (soldered electrical connections, for example). The test plan establishes training procedures and how additional information learned during the test period will be incorporated in the operating manual and taught to the system operators.

E. Environmental Emission Testing

PEI will conduct atmospheric emission testing as part of the complete test program. A separate test plan will be developed for the environmental emissions testing. This test plan will include procedures for controlling operations during environmental emissions tests and on coordinating testing of the FBPS and the atmospheric emissions test.

SECTION III. TEST PARAMETERS

The testing is divided into the following segments to facilitate evaluation of the test results and simplify data collection: Pre-FBPS , FBPS, Post-FBPS, and Parts Finishing Systems. Each of these segments represents unique data collection and testing. Evaluation of the project by segments will reduce the amount of data collection and the complexity associated with determining what parts to process and how to process them. Stepwise evaluation is practical because these processes are independent. Additionally, a stepwise evaluation facilitates ranking parts and makes processing the most likely candidate parts first practical.

A. Pre-Fluidized Bed Paint Stripper

Parts cleaned in the FBPS have been processed some before reaching the FBPS. Some of these pre-FBPS processing steps may be important in the overall determination of the effect of the FBPS on the part. The FBPS's usefulness can fairly be determined only by understanding these operations and how they affect the FBPS operation.

The pre-FBPS operations consist mostly of cleaning (steam, chemical baths, chemical washing, water washing, etc.) and disassembly. Steam cleaning is used to remove surface grime. It is also useful for reducing the oil and grease load to the FBPS. The removal of surface grime may be necessary as a particulate emissions reduction technique or to prevent excessive buildup of particles in the FBPS that do not fluidize properly. Where possible or useful steam cleaning will be used on parts prior to processing in the FBPS. Likewise chemical washing either as an additive to a steam or high pressure water wash or in a wash tank

can be used to reduce oil and grease, and grime loads to the FBPS before processing.

One of the intentions of the testing is to try and eliminate vapor degreasing even though vapor degreasing could be useful (like steam cleaning and chemical washing) to reduce the quantity of combustible material charged into the FBPS. Depending on the type of part and quantity of combustible material on a part vapor degreasing or other degreasing techniques may be necessary on parts before processing in the FBPS.

Further disassembly may be required for some parts. For example, a part may be damaged if processed in the FBPS with bearings in place. If the bearing will be removed and replaced after cleaning, removing the bearing before processing may prevent possible damage to the part because of differential thermal expansion. However, if the bearing can be left on the part while processing in the FBPS without adverse affects then further disassemble would not be necessary. Additionally, disassembly may be useful as a size reduction technique or to improve the "free flowing" configuration of a part.

Excluding selected parts from processing is an integral part of the Pre-FBPS operation. Parts are excluded that would be damaged by processing in the FBPS or ones that, by specification, cannot be subjected to the FBPS operating temperatures. Excluded parts include ones with plastics, solder, magnesium, excessive oil and grease, asbestos, or other materials that would create environmental or health hazards. Such parts will be identified in the initial screening process and the FBPS operator trained by the project manager in their recognition. During the course of this project additional test parameters regarding pre-processing of parts will be developed. As the additional parameters are developed they will be integrated into this test plan.

B. Fluidized Bed Paint Stripper

Three areas during the FBPS operations require data collection and allow for variability in the process; the hot bed, the transition from hot to cooling beds, and parts cooling. For the hot bed the primary test parameters are temperature and residence time. The bed temperature is key to the pyrolysis process and effects the residence time. Bed temperature can also affect the parts (temper, hardness, etc.). These will be monitored closely during processing of each part. Secondary hot bed processing parameters are the bed atmosphere (normally compressed air) and fluidizing rate (controlled to manufacturer's recommendations) these will not be monitored continuously. Because of the hazardous waste minimization nature of this project, the hot bed utility use (electricity, air, water, sewer) will be monitored.

The transition from the hot bed to parts cooling can affect part metallurgy. As part of the process description of each parts batch the FBPS operator will record the time to move the parts from the hot bed to the cooling bed, the movement method, and conditions of the move. This information may prove valuable in determining optimal processing methods and controlling metallurgical affects on parts.

Real time temperature changes in parts as they are processed could affect part metallurgy. No plans are included for such monitoring at this time. However, should the need arise, the project manager will develop such plans and have the plans included in the test plan.

All other monitoring will be done using dial type thermometers, stop watches, and system temperature indicators. This includes monitoring of ambient temperatures in the shop area and in the FBPS enclosure during part movements from the hot to cooling bed.

Parts cooling is another key area with regards to part metallurgy. Three methods of cooling will be tried; fluidized bed, water quench, and air cooling. The FBPS is initially configured for fluidizied bed cooling. Plans for air and water cooling will be developed and added to the test plan. For each method data on the cooling time and the before and after temperature of the cooling bed or fluid will be recorded by the FBPS operator. Additionally, the Project Manager will collect a complete description of the operation describing how the specific cooling method was accomplished. An initial set of processing parameters has been developed and is shown in Table 1.

C. Post-Fluidized Bed Paint Stripper

Post-processing (less finishing) is divided into five categories; media blasting (sand, stainless steel, walnut hulls, water, steam, etc.), chemical wash (caustic, corrosion inhibitors, acids, etc.), tumbling, heat treating, and others. For each part an appropriate combination of post-FBPS processes will be chosen by the project manager and RRAD staff. The choices will be based on part specifications and how well the part was cleaned in the FBPS. It is only through experimentation that the appropriate processes can be determined. As parts are tested and various post-FBPS processes used, data will be added to this test plan identifying the specific evaluation criteria and methods for determining process cleaning methods.

D. Parts Evaluation and Control

After parts are processed, they must perform as designed. No parts will be placed in service without approval of the project manager. Initial testing will be done on scrap parts followed by closely controlled tests on actual parts. As actual parts are processed in the FBPS, they will be meticulously tested before being put into service. The first parts tested will be

TABLE 1. PROCESSING CONDITIONS

HEAVY FERROUS

A. Heavy ferrous parts painted with no oil or grease
Hot bed for 80 minutes
Cooling bed for 80 minutes with media blast

B. Heavy ferrous parts with oil or grease
Hot bed for 60 minutes
Cooling bed for 60 minutes with media blast

C. Heavy ferrous parts painted with oil or grease
Hot bed for 120 minutes
Cooling bed for 120 minutes with media blast

LIGHT FERROUS

A. Light ferrous parts painted with no oil or grease
Hot bed for 50 minutes
Cooling bed for 50 minutes with media blast

B. Light ferrous parts with oil or grease
Hot bed for 40 minutes
Cooling bed for 40 minutes with media blast

C. Light ferrous parts painted with oil or grease
Hot bed for 60 minutes
Cooling bed for 60 minutes with media blast

HEAVY ALUMINUM

A. Heavy aluminum parts painted with no oil or grease
Hot bed for 40 minutes
Cooling bed for 40 minutes with media blast

B. Heavy aluminum parts with oil or grease.
Hot bed for 30 minutes
Cooling bed for 30 minutes with media blast

C. Heavy aluminum parts painted with oil or grease.
Hot bed for 50 minutes
Cooling bed for 50 minutes with media blast

LIGHT ALUMINUM

A. Light aluminum painted with no oil or grease.
Hot bed for 40 minutes
Cooling bed for 40 minutes with media blast

B. Light aluminum with oil or grease.
Hot bed for 30 minutes
Cooling bed for 30 minutes with media blast

C. Light aluminum painted with oil or grease.
Hot bed for 50 minutes
Cooling bed for 50 minutes with media blast

uniquely marked. The marking system will be developed in the field in conjunction with RRAD staff and RRAD managers to track parts and facilitate evaluation of any unanticipated field problems.

Mechanical testing will include determining the following, as appropriate: part dimensions, flatness/warpage, hardness, tensile strength and stress crack checks. Each of these tests will be done as needed on the first parts processed. Need will be determined based on the part use, part specifications, and judgment by the Project Manager. Where appropriate, the testing will be done by RRAD using routine testing techniques such as magnaflux, dye test, hardness testing, etc. Where additional testing is required, it shall be conducted at the direction of the Project Manager.

E. Part Finishing Systems

Painted parts will be tested for; paint adhesion to part, and salt spray/corrosion protection. Typical paints used meet various military specifications (mil specs). The following are the mil specs referenced most commonly; Epoxy-polyamide, Mil-C-22750, Aliphatic Polyurethane Coating, Mill-C-46167, Aliphatic Polyurethane Coating, Mil-C-53039.

Plated parts (cad, zinc, hard anodized, electroless nickel, chrome, etc.) will be tested for; plating adhesion to part, coverage, wear, and corrosion. Machined Parts will be tested for; dimensions bearing surfaces integrity, surface hardness, and machinability.

Many parts processed are old and painted with older paint systems such as:

TT-E-485, Enamel;
TT-E-529, Enamel;
MIL-P-1757, Zinc chromate;
TT-P-636, Red oxide;
MIL-C-52128, Forest green; and others.

Evaluation of these systems will be on the basis of how well they are removed in the FBPS. Removal of these systems in the FBPS result in special consideration of environmental emissions.

SECTION IV. CATEGORIZE PARTS

Because of the variability of the parts processed a method of categorizing the parts is necessary. There are several parameters important to parts categorization;

- Part is free-flowing;
- Combustibles;
- Environmental emissions;
- Size, shape, and coating; and
- Structural and/or mechanical integrity of the part.

A decision tree forms the basis of categorizing parts. Information on a part is collected in response to questions asked in the decision tree. Depending on the responses, the part is assigned a rank, as is indicated in the decision trees. The overall decision process is presented in Figure 1. Blocks 1, 2 and 3 are further expanded in Figures 2, 3, 4, and 5. As questions asked by each decision tree are answered, a part rank is assigned. The rankings are 1 to 4. Rank 1 parts are considered to have the best chance of successfully being processed. Rank 2 parts may be processable with moderate additional processing. Rank 3 parts may require extensive additional processing, and Rank 4 parts are not considered processing candidates. As parts are tested, their rank can be changed depending on the results of testing. For example, a Rank 3 part can be changed to a Rank 1 part if it can be successfully processed. Likewise, a Rank 1 part can be changed to a Rank 4 if it cannot be successfully reused.

The decision trees include two types of ranks: absolute and adjustments. An absolute rank is an assigned rank and takes precedence over the part's current rank. Adjustments are added or subtracted from the part's current rank.

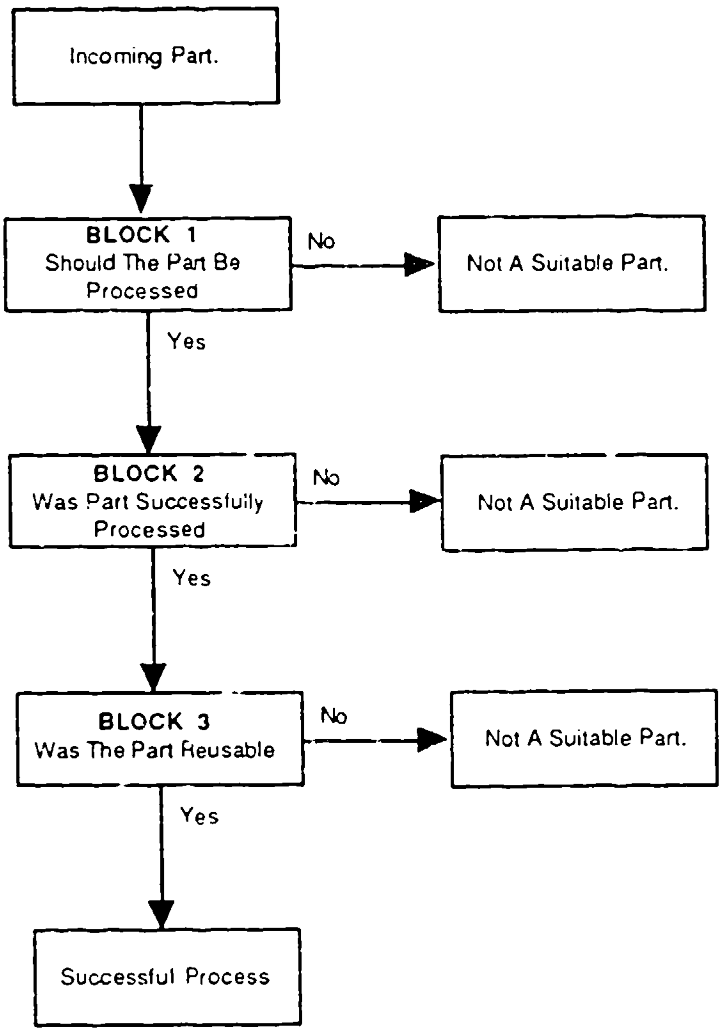

Figure 1. Overall decision process.

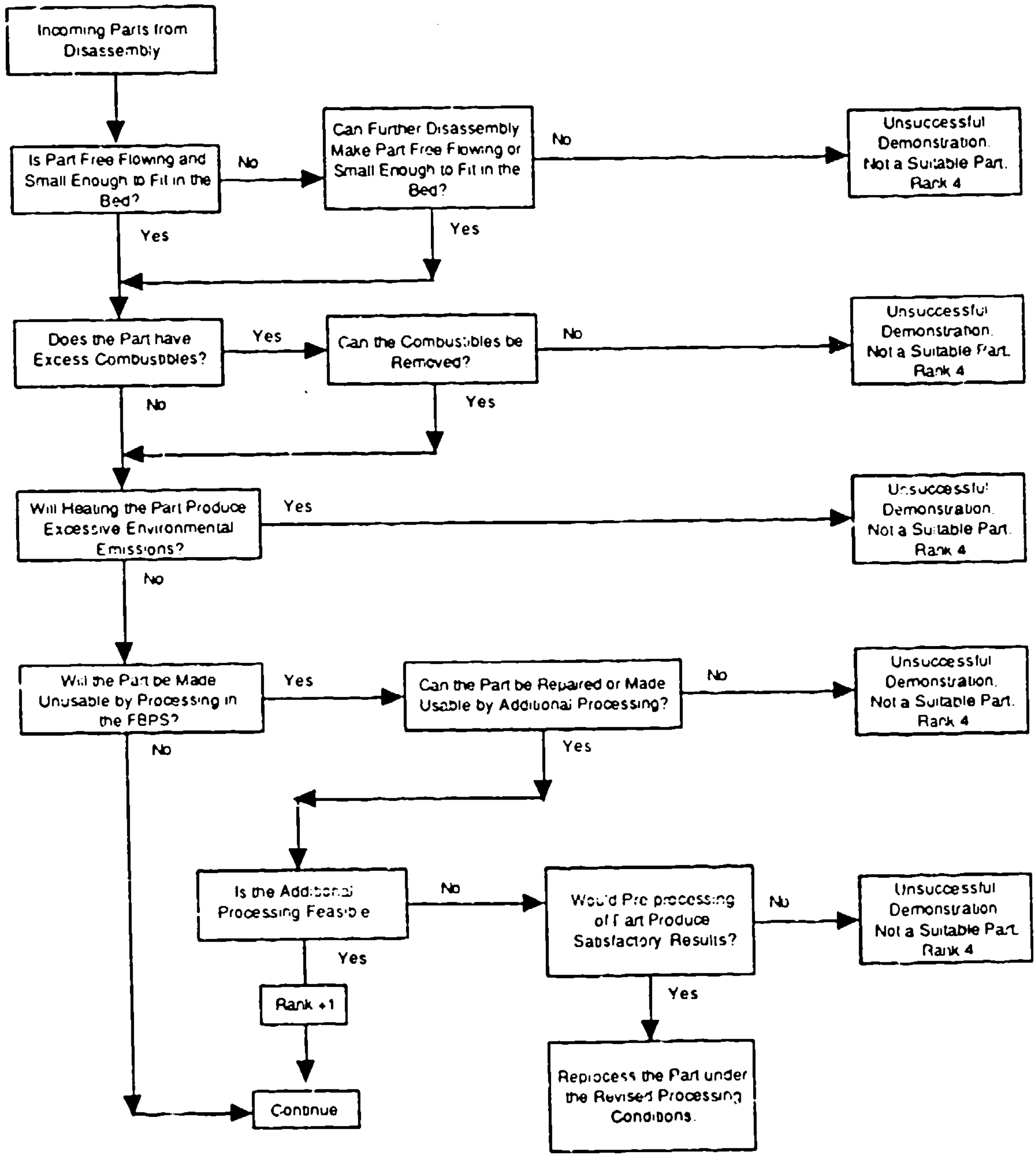

Figure 2. Block 1 - decision tree to decide if a part should be processed.

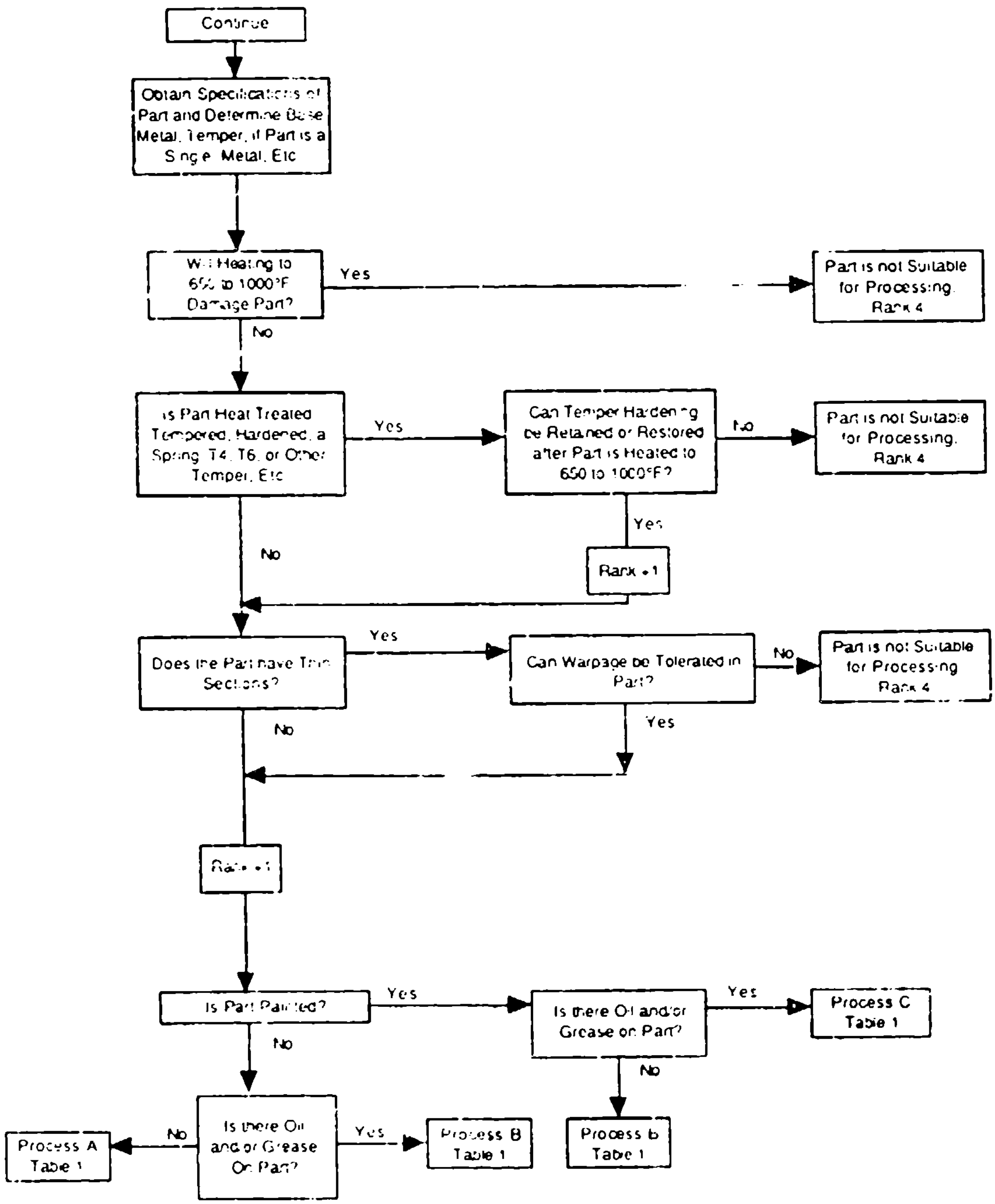

Figure 3. Continuation of Block 1 of processing decision tree

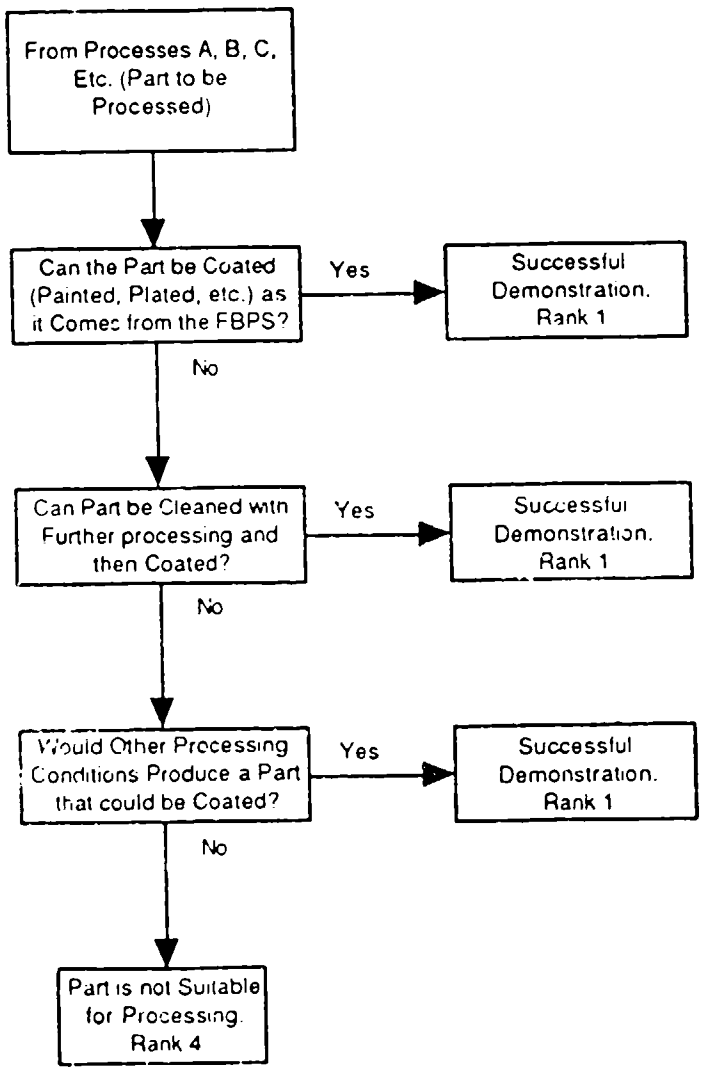

Figure 4. Block 2 - decision tree to decide if part was successfully processed.

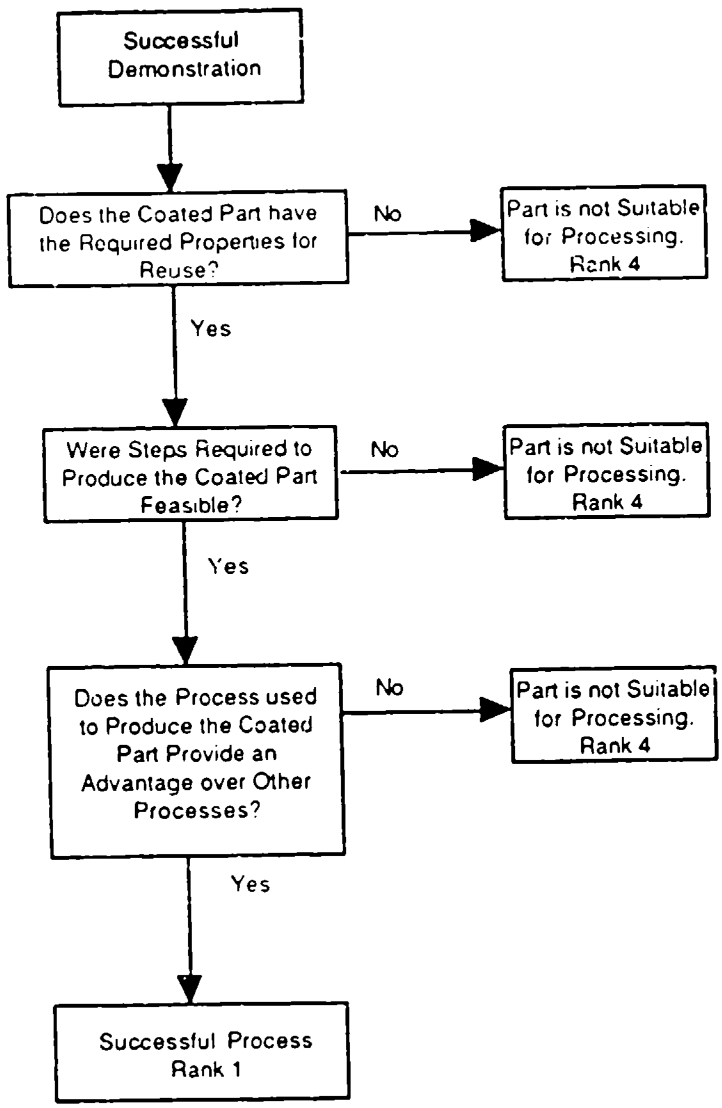

Figure 5. Block 3 - successful reuse decision tree.

The processing decision is made based on the physical properties of parts. The ranking process will be revised as the project progresses. The tentative ranking system developed is based on preliminary information. The following discusses the major factors considered in ranking parts.

A. Part is Free-Flowing

Effective operation requires that parts placed in and withdrawn from the FBPS not carry out the aluminum oxide heat transfer medium used in the bed. Also, the parts processed must allow the aluminum oxide to flow throughout the part to insure that the part is uniformly heated. The project manager and FBPS operator shall review, as part of the part categorization, the part geometry. The FBPS operator will determine if the part can be placed into the bed in such a manner that it will not trap the fluidizing media. The FBPS operator will help to control the circulation of the fluidizing media by appropriately stacking/loading the parts into the fluidized bed.

B. Minimize Combustibles

The fluidized bed heats parts to temperatures high enough to ignite most combustible materials (paint, oils, grease, plastic, foams, etc.). The system is designed to operate with an oxygen deficient environment and, thus, pyrolize most of the combustibles. The amount of combustibles that the system can burn is limited. Under normal operating conditions the bed is limited to the equivalent of 35 pounds of oil in a single charge. To measure the amount of combustibles included with a typical charge is impractical. Therefore, combustibles will be controlled by the FBPS operator by inspection and judgment. This requires that the operator have the authority to refuse to process parts if he believes that they contain excessive combustibles, PVC, or halogenated materials.

Additional procedures are in place that require review of which parts are processed in the FBPS. These procedures require rejection of parts that have excessive combustibles. Sometimes this will require testing to measure the amount of combustible material on the part.

Testing will be done gravimetrically. Parts will be weighed to within 0.1% of the part's weight. The weight of the part will be recorded and the part cleaned, as appropriate, of all combustible material and the part reweighed. The quantity of the combustible material is then determined by difference. By inspection and knowledge of the type of material the oil equivalence of the combustible material (based on the heat content of the material) will be determined and recorded. From this information the project manager will determine if the part is suitable for processing.

C. Environmental Emissions (Cadmium, Zinc, PVC's, Oil & Grease, Etc.)

The FBPS is equipped with an emissions control system to minimize environmental emissions. The system has two components; an afterburner to control hydrocarbons and the pyrolysis products and a wet venturi scrubber to control the particulate emissions. The afterburner is a natural gas fired combustion chamber that incinerates all combustible materials and convert them to water vapor and carbon dioxide.

The air permit for the unit has specific operating limits and environmental emissions limits and does not allow processing of parts that contain PVCs and halogenated materials. Because the emission control system can control only a limited amount of the environmental emissions, it imposes limits on the amount and kind of materials that can be charged into the FBPS. The afterburner has finite limits on the quantities of material that it can incinerate (35 pounds of oil equivalent). The wet venturi

scrubber has limitations on the kind and quantity of material that it can effectively control (particulate). Heavy metals are of special concern, especially Cadmium and Zinc.

Cadmium and Zinc are common plating metals used on parts planned for processing in the FBPS. At the bed temperatures these metals probably will volatilize and/or oxidize and leave the bed. In the afterburner any metal vapors will be converted to oxides and pass to the venturi scrubber. The scrubber is a low energy venturi and is expected to have a moderate collection efficiency on the metal oxide particles found in the process. To keep emissions of these oxides to acceptable levels the amount of the metals charged into the FBPS must be controlled. Control of these materials will be the responsibility of the FBPS operator.

The operator will be responsible for regulating the quantity of these metals charged into the bed. Basic information from drawings and knowledge of the parts will define which parts potentially have cadmium or zinc plating. Suspect parts will be visually inspected to determine if they do or could have plating. If the part is suspect it will be treated as if it is plated. From Table 2 the operator will determine how many of the particular part can be charged to the FBPS and limit the charge to that amount. The project manager and staff will work with the FBPS operator to develop specific written instructions for controlling the amount of cadmium and zinc charged in the FBPS. The instructions will include a copy of Table 2 that shows the number of parts per charge and the weight of plating per unit weight of charge so the FBPS operator can determine the allowable number of parts per charge. The operator will determine the weight of cadmium and zinc charged and limit the amount of charge to acceptable limits.

Lead and chrome are used in coatings processed in the FBPS. The fate of these metals will be determined during the project. It is theorized that most of the lead and chrome will remain with

TABLE 2. PART GEOMETRY AND QUANTITY OF PLATED

Part geometry charge	Number of parts per charge
1/4 to 1/2 diameter and 1 to 2 inch length	2,000
1/4 to 1/2 diameter and 2 to 6 inch length	700
1/2 to 1 diameter and 1 to 2 inch length	1,000
1/2 to 1 diameter and 2 to 6 inch length	350
1/2 to 1 diameter and greater than 6 inch length	60
1 to 2 diameter and 4 to 10 inch length	100
1 to 2 diameter and greater than 10 inch	30

For other configurations compute the plated surface area. Each charge is limited to 50 square feet each of cadmium and zinc.

the char on the parts; however, this will be verified during the project.

D. Size, Shape, and Coating

The parts will be categorized by whether they are thin, thick or complex sections. For example, a flat plate like panel of less than 10 gauge material is considered a thin section where a connecting rod, bolt, or casting is a thick section. Complex sections are typically fabricated parts, like a support bracket or an engine block.

Besides the type of section, parts will be categorized by the coating system. The coatings are paints, plating, and oils and greases. Paints are further divided into the CARC (chemical agent resisting coating), polyurethanes, and enamels. Plating are divided into Cadmium and Zinc and others such as Electroless nickel and chromium. Oils and greases are categorized as a combustible material and their input will be controlled. Each of these categories may effect the way a part is processed.

E. Structural and/or Mechanical Integrity

As parts are tested, the bed operating temperature could alter the structural and/or mechanical integrity of parts. Specific tests will be performed on selected parts to verify what effect processing in the bed has on a part. The tests will be directed by the project manager based on knowledge of the part's metallurgy and how bed temperature would affect that metallurgy.

Work hardening and temper are two of the more important properties of the parts that will be considered. If the work hardening and/or temper of a part will be changed and could not be restored after processing in the FBPS or removed without adversely affecting the part, the part is not a candidate for processing. The FBPS will remove all work hardening and temper from the aluminum parts.

1. Ferrous Parts

Ferrous parts tend to be less effected by the bed temperatures. They are less likely to have a special temper or heat treating that could be damaged by processing in the FBPS. However, some ferrous parts can be damaged at bed conditions and each part must be investigated to determine if the part will be damaged by processing in the FBPS.

2. Non-ferrous Parts

The non-ferrous parts are mostly aluminum. The aluminum parts represent some unique situations because of work hardening and temper. For reasons similar to those for the ferrous parts the non-ferrous parts are categorized by simple thin and thick sections, complex sections, coating systems and metal treatments. Additionally the non-ferrous parts are categorized by whether they have been tempered, work hardened, or surface hardened. They also are categorized by alloy.

Determination of the temper, alloy, hardening etc. requires review of the part specifications usually contained on the part drawings. This review is a part of the total evaluation process and will be done on a part by part basis. Once determined a part will be categorized and a decision made by the project managers on whether the part is a potential processing candidate and its rank.

Castings and wrought aluminum alloys may require different processing and are therefore a potential category. This information will be determined during the initial evaluations of the parts by the project managers. The information on the part will be found with the part specifications and drawings and will be recorded by the project manager during the evaluation of the part.

F. Excluded Parts

PVCs will not be allowed in the bed. The incinerator has the capacity to incinerate them and the scrubber can control most of the combustion product. However, the operating permit does not allow them in the bed.

Parts that have solder or solder like materials will not be processed in the bed. The FBPS operator must know which types of parts might have solder or solder like materials and make sure that these parts are not processed in the FBPS.

Parts that contain foams, plastics, paper, cloth, webbing, etc., will not be allowed in the bed. For example, personnel carrier seats with webbed belts are not to be processed in the bed. Once the webbed belts are removed from the seat, the seats can be processed. Seat cushions (foam) and plastic part covers will not be processed. If these can be removed from a part then the part may be processed.

Magnesium is used as an alloy agent in much of the aluminum processed by the RRAD. Only a few parts contain enough magnesium that they pose a potential hazard. Magnesium could ignite and cause a violent reaction in the bed, damage the bed, and potentially be a hazard to the personnel in the area. Special precautions will be necessary to prevent magnesium parts from being processed in the FBPS. These procedures shall parallel the existing procedures used to identify and control processing of magnesium parts.

Currently, the magnesium parts are segregated from the other parts and cleaned separately. There is no intention to change that process. Therefore, these parts should not enter the area where the FBPS is operating. Still, the operator must be aware that magnesium parts will be in the area and trained in the recognition of those parts. Since there are only a few of the magnesium parts this training is not considered difficult.

Asbestos is present in various gaskets and an ablative coating. At bed conditions, the asbestos would be freed from the organic matrix holding it together. Once freed, the asbestos could become airborne, escape from the enclosure during charging or maintenance, and cause a health hazard to people in the area.

SECTION V. PARTS DATA

Parts data will be collected on two levels; specific, and generic. The part specific data will be collected during testing of specific parts or groups of like parts. These data include number of parts being tested, condition of parts (painted, oily, etc.), test run number, etc. The generic data are collected from engineering and design data. These data include such things as part heat treatments, type of metal, surface finishes or treatments, etc. The data will be merged as necessary in the data reduction. This section discusses methods of collecting and maintaining the parts data and the various data sheets used to collect and record the parts data.

A. Uniquely Mark Parts

Parts being tested initially will require special marking to insure that they have been properly certified as not having been adversely affected by processing in the FBPS. Parts shall have 1/16" thick, 1" round uniquely numbered aluminum tags attached with 3/32" diameter soft aluminum wire. The marking numbers assigned to parts will be recorded in the project log book. The log book will be controlled by the project manager and no number will be assigned without it being immediately recorded in the project log book. This procedure should prevent duplication of part numbers.

Some parts cannot be effectively tagged. These are typically the very small, round, slender parts and some castings. For these parts no identification number will be affixed to the parts instead the parts will be identified with descriptions and by controlling position of the containers holding the parts. A special system of containers will be used to hold parts being

evaluated. These containers will be marked with a stencil identifying them as test parts and with a bright yellow paint on the upper edge of the container.

B. Record Part Numbers

Each part type has a unique identification number. Sometimes this number is marked on the part. The number can be part of the casting, stamped into the part or on a permanently affixed identification tag. Some parts do not carry a part number. These unmarked parts are identified by visual inspection and knowledge of the types of paint being processed. For all parts, the part number is listed on various inventories and in various specifications documents. The staff will be responsible for locating and recording the part number by inspection of the part or consulting the various inventories, part drawings, and technical documents maintained by the project manager. Figure 6 shows the data sheet that will be used to collect part-specific data. The part number will be recorded on this data sheet. Figure 7 is a sample of a completed data sheet.

C. Obtain Part Drawings

Part drawings will be obtained, if possible, for all parts processed. The part drawings will be clearly identified with the part number. The drawings will be maintained in a central file by the project manager. Where the drawing references additional drawings or specifications that information will be collected by the project manager and reviewed to insure that all necessary information on the part is available for evaluation.

The part drawings form a key element in the complete evaluation of the parts. The drawings typically contain information on the part dimensions, tolerances, finishes, heat treating, etc. They also contain information on the various specifications that apply to the part.

Vehicle part is used on: ____________________

Part Number: ____________ Part Name: ____________

Drawing Number: ____________ Part Description: ____________

Material(s) of construction: ____________ Mil Spec Number: ____________

Finishes

Plating type(s): ____________ Mil Spec Number ____________

____________ Mil Spec Number ____________

Paint(s): ____________ Mil Spec Number ____________

____________ Mil Spec Number ____________

Other(s): ____________ Mil Spec Number ____________

____________ Mil Spec Number ____________

Part maximum dimensions

L______ in. W______ in. H______ in.

Part weight: ________ pounds

Part surface area: ________ square inches

Part type

Thin section ☐

Thick section ☐

Complex section ☐

Methods of fabrication

Stamping ☐

Forging ☐

Casting ☐

Fabricated ☐

Heat Treatment

Tempered ☐

Hardened ☐

Mil Spec Number: ____________

Figure 6. Part-specific data collection sheet and instructions.

INSTRUCTIONS

Vehicle part is used on: Identify the vehicle family (eg., Bradley, 113 etc.)

Part number, drawing number, part description, and material of construction & mil spec number: Transfer these from the drawing or other sources.

Finishes and mil spec: Transfer these from drawings and specifications for part.

Part dimensions: Measure part maximum dimensions.

Part weight: Weight to nearest pound.

Part surface area: Approximate and record in square inches.

Part type, method of fabrication, and heat treatments: Determine by inspection and check the appropriate boxes. Determine the mil spec for heat treatment from specifications and record.

Figure 6. (continued)

Vehicle part is used on: Bradley

Part Number: 012345678 Part Name: Latch, hatch

Drawing Number: 012345678 Part Description: handle

Material(s) of construction: Cast steel Mil Spec Number: 00-000-000

Finishes

Plating type(s): anodized Mil Spec Number 00-000-000

Mil Spec Number

Paint(s): CARC Mil Spec Number 00-000-000

Mil Spec Number

Other(s): Mil Spec Number

Mil Spec Number

Part maximum dimensions

L 8 in. W 2 in. H 1/4 in.

Part weight: 1 pounds

Part surface area: 5 square inches

Part type

- Thin section [ ]
- Thick section [X]
- Complex section [ ]

Methods of fabrication

- Stamping [ ]
- Forging [ ]
- Casting [ ]
- Fabricated [ ]

Heat Treatment

- Tempered [X]
- Hardened [ ]

Mil Spec Number: 00-000-000

Figure 7. Completed data sheet.

D. Record Complete Information on Data Sheets

Keeping track of the operational data for several hundred parts will not be a simple task. The project team will use a series of data sheets to collect data. The test plan includes instructions on the preparation of the data sheets. Each part or group of like parts processed will have a unique lot number and data sheet. The data sheet will be used to record all information on the processed part(s). Figure 8 is a blank test data sheet and instructions. Figure 9 is an example of a completed test data sheet. Since this is a research and development project data will be extensive. As the project develops the data sheet may be modified.

How a part is handled can effect the performance of the part. Tempered aluminum parts, if heated and cooled in a specific manner, will still be tempered after processing. Tempered aluminum parts, if not processed properly, lose their temper and become unusable. Also, a steel part that is exposed to moisture shortly after being processed would develop rust that could make the part unusable without further processing where, if protected from moisture after processing, it would be usable without additional processing.

Figure 10 is a data sheet and instructions designed to collect the pre- and post-processing data on parts. The data sheet has two modes: specific and generic. The specific mode is when the pre- and post-data are specific to a unique part and the generic mode is used for a class or type of part. Figure 11 is an example of the form completed for a generic type part and Figure 12 is an example of the form completed for a specific part.

Test number: _______ Test start time: _______ Test stop time: _______ Test date _______

Basket configuration

Number: _____ Random ☐ Stacked ☐ Other (describe) ______________________

Charge

Weight of basket: __________ lb

Steel: __________ lb

Aluminum: __________ lb

Iron: __________ lb

Mixed/other: __________ lb

Total charge weight: __________ lb

Temperatures

Parts before charge: __________ °F

Hot bed:

Initial: __________ °F

Final: __________ °F

Cooling bed:

Initial: __________ °F

Final: __________ °F

Parts after cooling bed: ______ °F

Times intervals

Time in hot bed: ________ minutes

Time to transfer from hot to cool beds: ________ minutes

Time in cooling bed: ________ minutes

PART PARAMETERS

Specific part number	Part description	Total weight of parts	No. of parts in charge	Weight of combustibles	Part color		Comments and Observations
					Before FBPS	After FBPS	

Figure 8. Test data sheet and instructions.

INSTRUCTIONS

Test Number: Assign next number from project log book.

Test start & stop time: Use military time recorded from reference clock areas.

Test date: Enter two digit day number, three letter month abbreviation, and two digit year.

Basket configuration: Show number marked on basket check appropriate block if parts are loaded randomly or stacked; describe "other" such as "used fixture to stack parts".

Charge: Record tare weight marked on basket and actual or estimated weight of total steel, aluminum, iron, and mixed or other metals and the total charge weight including basket.

Temperatures: Record indicated temperatures in degree Fahrenheit from instruments as indicated.

Time intervals: Record elapsed time to nearest minute from stopwatch.

Part parameters: Complete for each part type in charge.

Specific part number: Collect and record one for each part type in charge.

Part description: Use part description found on part drawing or other graphics description if part description on drawings is not found.

Total weight of part: Record to nearest pound.

No. of parts in charge: Record count of parts.

Weight of combustibles: Record estimate of total weight on all like parts.

Part Color: Describe and record part color.

Comments and observations: Record anything unusual and comment on cleanliness of part or if paint/coating removes easily after processing.

Figure 8. (continued).

Test number: 15 Test start time: 1420 Test stop time: 1630 Test date 08 AUG 90

Basket configuration

Number: 1 Random ☐ Stacked ☐ Other (describe) ______

Charge

- Weight of basket: 156 lb
- Steel: 444 lb
- Aluminum: ______ lb
- Iron: ______ lb
- Mixed/other: ______ lb
- Total charge weight: 758 lb

Temperatures

- Parts before charge: 98 °F
- Hot bed:
  - Initial: 850 °F
  - Final: 850 °F
- Cooling bed:
  - Initial: 100 °F
  - Final: 100 °F
- Parts after cooling bed: 110 °F

Times intervals

- Time in hot bed: 60 minutes
- Time to transfer from hot to cool beds: 5 minutes
- Time in cooling bed: 60 minutes

PART PARAMETERS

Specific part number	Part description	Total weight of parts	No. of parts in charge	Weight of combustibles	Part color: Before FBPS	Part color: After FBPS	Comments and Observations
12345678	Cylinder sleeves	105	10	2	Black	Grey	all parts appear well cleaned
23456789	Brackets	51	100	0	Green	Green	paint flakes off easily
34567890	Road arm	250	10	2	Green	Green	paint flakes off easily
45678901	Mounts	196	20	0	Green	Green	paint flakes off easily

Figure 9. Completed example test data sheet.

PRE-PROCESSING DATA

Part number: ____________________

Part ID, if applicable: ____________

Date form initiated: ____________

Date form completed: ____________

Is part usable? (Y/N): ____________

Describe precleaning done on part:

____

____

____

Is part completely disassembled? (Y/N)

____________ If No, describe

components: ____________________

____

____

FBPS test number associated with paint: ____________________

FBPS test date: ____________________

POST-PROCESSING DATA

Describe storage conditions: ________

____

____

____

Describe part cleaning: __________

____

____

____

Describe part heat treatment: ______

____

____

____

Describe part testing: ____________

____

____

____

Describe part reuse evaluation: _____

____

____

____

Describe part recoating (painting/plating): ____________________

____

____

____

Figure 10. Pre- and post-processing data sheet and instructions.

PRE-PROCESSING DATA

Part number: Collect and record from drawing or other source.

Part ID (if applicable): Use only for specially tagged parts (aluminum tag). Record number from tag on part.

Date initiated and completed: Since the part evaluation may take several days, record these as appropriate use in a two digit day number, three letter month abbreviation, and two digit year.

Is part usable (Y/N): Record "N" for no, if part is a salvage, otherwise record "Y" for yes.

Describe precleaning done on part: Record known information or "unknown" if no information on precleaning is available.

Is part completely disassembled (Y/N): Record "Y" for yes or "N" for no.

If no, describe component: Give verbal description components to part.

FBPS test number associated with part: Indicate required number

FBPS test date: Record date of FBPS test.

POST-PROCESSING DATA

For each item, give a verbal description of the requested items. Where additional data sheet on information is collected, identify with part ID or part number and attach to form.

Figure 10. (continued).

PRE-PROCESSING DATA

Part number: 12345689

Part ID, if applicable: ____________

Date form initiated: 08 Aug 90

Date form completed: 15 Aug 90

Is part usable? (Y/N): Y

Describe precleaning done on part: Water washed to remove mud

Is part completely disassembled? (Y/N) N If No, describe components: Part is road arm casting with press fit bearing

FBPS test number associated with paint: 15

FBPS test date: 08 Aug 90

POST-PROCESSING DATA

Describe storage conditions: Part was stored inside

Describe part cleaning: Part was blasted with walnut hulls

Describe part heat treatment: None

Describe part testing: Hardness testing result was 46C

Describe part reuse evaluation: Bearing removed and replaced and part considered reusable

Describe part recoating (painting/plating): Part masked and prime painted after aladine wash and finish coated with CARC

Figure 11. Completed pre-/post-processing data sheet for a generic type part

PRE-PROCESSING DATA

Part number: 23456789

Part ID, if applicable: 535

Date form initiated: 08 Aug 90

Date form completed: 15 Aug 90

Is part usable? (Y/N): N

Describe precleaning done on part:

None

Is part completely disassembled? (Y/N)

Y If No, describe

components:

FBPS test number associated with paint: 15

FBPS test date: 08 Aug 90

POST-PROCESSING DATA

Describe storage conditions: Part was stored outside for two days after FBPS process

Describe part cleaning: Part blasted with glass beads

Describe part heat treatment: None

Describe part testing: Part size measured and within tolerances

Describe part reuse evaluation: Part is salvage. However, FBPS processing did not affect reuse

Describe part recoating (painting/plating): None

Figure 12. Completed pre-/post-processing data sheet for a specific part.

E. Maintain Computerized Data Base of Parts

The data collected on the form will be transferred to a computerized data base for storage and retrieval. The data base will be maintained by the project manager. The data base management system will have extensive capabilities regarding sorting and retrieval of data. As the system is developed, additional details will be collected and added to the list plan.

SECTION VI. PRE-OPERATIONAL TESTING

The FBPS equipment is expected to take approximately 40 weeks from placement of order until completion of installation. However, the manufacturer has available a smaller demonstration FBPS at their facility. Selected parts will be shipped to the manufacture for testing prior to completion of the RRAD FPBS system. These tests will be used to refine the data collection objectives and provide information used to revise this test plan. Because of the limited access to the FBPS at the manufacturer only a few parts can be tested. The exact quantity of parts that can be tested will be developed as the project progresses.

The manufacturer's test bed is only 24 inches in diameter and 30 inches deep. This is smaller than the RRAD FBPS. Therefore, the parts that can be tested will be smaller than those that can be tested at RRAD. The parts selected for testing at the manufacturer will be selected so that they can fit in the test bed. The test bed has a fluidized cooling bed; water quench is possible, depending on part size and material type. The test bed will not be used except on an available basis.

VII. OPERATION DEMONSTRATION

Once the system is installed at RRAD, the manufacturer and PEI will conduct testing to evaluate the system and accept the equipment. To make the most of this testing, parts that are scheduled for testing will be used for the operational demonstration. The parts chosen for the operational demonstration will be parts that have the maximum possibility of successful processing, are the maximum size and weight, and contain maximum combustibles. These parts will be selected and accumulated by the project staff.

The most likely initial test parts are engine parts (blocks, heads, connecting rods, cylinder sleeves, etc.). These are some of the simpler parts to evaluate from a metallurgical and refinishing aspect and one of the major components planned for processing in the FBPS. Thus, engine parts are ideally suited for the operational demonstration. Additionally, engine parts are plentiful, which will be useful should the equipment require modification and retesting.

VIII. OPERATIONAL TESTS

The operational tests will be iterative. A best estimate of how each part can be processed will be made. The part will be processed on the basis of that initial best estimate. Following processing the condition of the part will be reviewed by the project staff. Depending on the results of the review the processing sequence will be modified. As more information on various parts is collected the ability to make generalizations on processing will be developed. As those generalizations develop they will be added to the test plan.

Most parts will not receive a comprehensive evaluation. Instead a comprehensive evaluation will be conducted on the most probable processing candidates. A comprehensive evaluation will include testing with several pretreatment options, testing with various bed conditions and cooling methods, use of several of the post treatment options, and finishing the parts in all possible configurations. Several different parts of the same type will be used for the comprehensive evaluations. These will include scrap parts to minimize cost. Usable parts will be evaluated in the final phase of the comprehensive evaluations to confirm that the best processing sequence produces a useable part.

Following each processing sequence and at each phase the testing is re-evaluated by the project staff. If the processing is unsatisfactory or the staff believes better results are possible the test parameters are modified and the test repeated.

As part of the evaluation the project staff will determine the success of the reuse. Figures 3 and 4 show decision trees used to demonstrate how the success of processing and reuse is determined.

As time permits, parts of lower priority will be evaluated. As the testing progresses to the evaluation of lower probability of processing parts, more innovative processing methods will be required. This is consistent with the evolution of a research and development project. Therefore, to leave the most difficult problems until the last is logical.

IX. DATA EVALUATION

The data from the testing will be qualitative and quantitative. Ease of use, part appearance, processing simplicity, etc. are qualitative judgments produced from this testing. Evaluation of such data in mathematical or quantitative terms is not practical. Instead, these will be assigned a pass/fail value and recorded in the evaluation.

The quantitative results (hardness, temper, dimensional stability, flatness, etc.) are a significant portion of the final determination of acceptable FBPS operation and evaluation. Frequently, the quantitative differences will be small. Therefore, statistical analysis will be used to determine the parameters significance. Once determined, the quantitative data will be reduced to a pass/fail value and recorded in the evaluation. If all factors are passing, then the FBPS processing is successful. If any one determination is a failing value then the FBPS processing is unsuccessful.

SECTION X. REPORT

The report is intended to provide a discussion of what was done, why, and the testing conclusions. It is also intended to be a means of submitting the data collected. The report is included as a section in the test plan because part of the test objective is to collect data and report on the findings. Therefore, an outline of the report is included in the plan to ensure the testing meets the reporting objective.

The report will be organized in the following chapters:

1. Introduction
2. Description of parts tested
3. Description of test results
4. Discussion of the evaluation criteria
5. Recount the operational test parameters
6. Present the recommended parts control parameters
7. Recommended additional testing
8. Conclusions

The following subparagraphs discuss the intent of each of the report Sections.

A. Introduction

The report introduction will be much like the introduction to this test plan. It will describe the report objectives and organization.

B. Description of Parts Tested

Section 2 of the report will document the types of parts processed at RRAD. The report will include a discussion of both the parts processed and the parts not processed. The RRAD processes parts that include lightweight aluminum and aluminum alloy housings, electrical components, armaments, engine and drive components, mechanical connections, fixtures, etc. Some of these are not candidates for processing in a FBPS. The report will

discuss all parts, however, the candidate parts will be discussed based on the part category and suitability for processing and priority.

C. Description of Test Results

The test results will be presented in both absolute terms and statistical terms. The description will present a tabulation for each part category, the processing time for each coating system, and the success of the processing sequence reported. This section will discuss the methods used to categorize and set the parts priority and introduces the test results. The data collected during all phases of the testing will be summarized in this section. The actual test data will be available as a separate document.

D. Discussion of the Evaluation Criteria

Section 4 of the report will present the sequence of evaluations used to determine the priority of the parts. It will also present specific categories of parts and test methods and the basis of judging if a part was successfully processed.

E. Recount the Operational Test Parameters

Section 5 of the report will summarize the operational test parameters investigated. It will discuss the various phases of the testing and the data collected. Most of the information in this section of the report will be extracted from Section V of this test plan.

F. Present the Recommended Parts Control Parameters

Section 6 will present a series of recommendations developed after the test. The discussion includes a determination of parts that are suitable candidates for FBPS processing and operational procedures to optimize FBPS use. These will possibly include such procedures as:

- Determining the base metal type and any heat treating,
- If warpage is a potential problem based on the geometry, material type, and thickness,
- Type of coatings,
- Presence of combustibles on the part,
- Presence of heavy metals, etc.

G. Recommended Additional Testing

Section 7 will make recommendations for additional tests as appropriate.

H. Conclusions

The conclusions will be based on the testing. The report will discuss the usefulness of the FBPS based on how well it functions as a cleaning device and how effectively it reduces hazardous waste generation.

APPENDIX C

PARTS INCLUDED IN THE FBPS EVALUATION

Figure	Part Number	Description	TM	Material/Comment
109	8756255	Anchor Plate	2300-257	4140
138	8756258	Anchor Plate	2350-261	4140
109.1	8756258	Anchor Plate	2300-257	4140
113	10866132	Track Idler Arm Assy (Less Bearing 11633894)	2300-257	? Prob 4140
143	10874930	Track Tens. Bracket	2350-261	4140H
114	10874930	Track Tension Bracket	2300-257	4140H
147	10907799	Metal Tire Wheel	2350-261	CST ST CLS 120-95
116,116.1	10907799	Metal Tire Wheel	2300-257	CST ST CLS 120-95
120,120.1	10918160	Road Wheel Arm Support Housing (Less Bearing 10875366)	2300-257	CS (ALSO SEE 10918159)
139	10918160	Pivot Arm Assembly (less Support Bearing 10875366)	2350-261	CS
120	10918161	Arm Assy.	2300-257	? Prob 4140
120	10918162	Arm Assy.	2300-257	? Prob 4140
142	10932828	Nondr Spindle Wheel	2350-261	? Prob 4140
113	10932828	Idler Support Spindle	2300-257	? Prob 4140
145	10942567	Sprocket Wheel	2350-261	CST ST GR 105-85
117	10942567	Sprocket Wheel	2300-257	CST ST GR 105-85
120	11598503	Arm Assembly (Like 12268700)	2300-257	Temper Weld 500°F (ALSO See 8756363,10866123,11660920)
140	11598503	Pivot Arm Assembly (Like 12268700)	2350-261	Temper Weld 500°F (ALSO See 8756363,10866123,11660920)
141	11669356	Idler Arm Spindle	2350-261	? Prob 4140
113.1	11669356	Idler Support Spindle	2300-257	? Prob 4140
148	11667359	Rear Guard	2350-261	4130H-4140
119.1	11669359	Shock Absorber Guard	2300-257	4130H-4140
119.1	11669366	Shock Absorber Guard	2300-257	4130H-4140
148	11669366	Road Wheel Arm Guard	2350-261	4130H-4140
116.1	11669373	Metal Tire Wheel	2300-257	CST ST GR 120-95
147	11669373	Flat Pulley	2350-261	CST ST GR 120-95
113.1	12253578	Idler Track Arm Assembly (Less Bearing 11633894)	2300-257	SEE 11669358,11669367,11669365
141, 142	12253578	Track Arm Assemble (Less Bearing Sleeve 11633894)	2350-261	SEE 11669358,11669367,11669365
120.1	12253620	Support Arm Assy	2300-257	? Prob 4140
139	12253620	Support Arm Like 12268688	2350-261	? Prob 4140
140	12268628	Support Arm Like 12253620	2350-261	? Prob 4140
120.1	12268700	Support Arm Assy (Like 11598503)	2300-257	SEE 10866123,8756363,11660920
139	12268700	Arm Assembly (Like 11598503)	2350-261	SEE 10866123,8756363,11660920
79&81	12276657	Support Housing (Less Bearing 12296924)	2350-252	FS 4130
73	12295281	Idler Support Spiindle	2350-252	? Prob 4140
75	12295283	Spindle	2350-252	? Prob 4140
78	12295290	Wheeel Spindle	2350-252	CST ST GR 120-95
79&81	12296932	Pivot Arm Assy	2350-252	SEE MS16555-63,12295288,12296925,12297029
71	12297027	Spindle	2350-252	?
75	12328850	Idler Wheel Arm (Less Bearing 12276924)	2350-252	?

List of All Drawings/Parts Inc. Material Specs

Drawing Number	Description	Assembly Number As Tested	Test Number	Materials Primary/ Secondary
2	CPCX2 REDUCING PIPE TEE	999	0	
20	NP20 PILLOW BLOCK BEARING	20	0	
16555	MS16555 HEADLESS ST. PIN	999		
21044	MS21044E NUT	12253531	0	
35671	MS35671 GROOVED PIN	10949818	0	CDS
51335	MS51335 TOWING PINTLE ASSEMBLY	51335		
51504	MS51504 PIPE ELBOW, ETC.	999	2	
53075	MS53075 NON VENTED TANK CAP	999	0	
90726	MS90726 SCREW, CAP, ETC.	999		
104235	RIVIT	5605888		
560583	SPRING	5605888		
5109549	V6 ENGINE WATER SYSTEM	5109549	1	
5109688	FRONT COVER	5109688	0	
5121109	V6 PULLEY	5121109	4	
5121343	ENGINE COVER FITTING	5121343	1	
5124762	TRUNNION	5124762	4	
5125488	ENGINE LIFTING LUG LEFT	5125488	1	
5127238	AIR HORN	5127238	0	
5127949	ENGINE LIFTING LUG RT.	5127949	1	
5132473	V6 ENGINE HEAD WATER SYSTEM	5132473	1,25	
5135296	AIR HORN BASE	5135296	0	
5135838	OIL PAN	5135838	5	ST
5266289	WASHER	5605888		
5605875	OIL CAN STOWAGE MOUNTING BRACKET	5605888		

Drawing Number	Description	Assembly Number As Tested	Test Number	Materials Primary/ Secondary
5605888	OIL CAN STOWAGE MOUNTING BRACKET	5605888		
6226763	SPRING	5605888		
6774436	Oil Pan	6774436	6	ST
7044253	SPRING	7524312		
7355390	PINTLE HOOK	7355390		
7359523	SPRING	5605888		
7359524	OIL CAN MOUNTING BRACKET ASSY.	5605888	0	
7524312	LOCK ASSY. PINTLE	7524312		
7524313	LATCH	7524312		
7524314	LOCK	7524312		
7528105	FUEL TANK FILLER BAYONET	10861293		
7954475	AUTOMATIC BREAK CASE	7954475		
7954484	GEAR CASE	7954484	2	
8364016	CHANNEL (RADIO RAIL)	8364016	0	
8376495	WEATHERCAP (COMMERCIAL)	8376498	7	
8376498	WEATHER CAP (COMMERCIAL)	8376498	7	
8380197	DUMMY DRAWING	0		
8447117	RH PIVOT PLATE	8447117		
8456497	SPEEDOMETER ADAPTER	8756252		
8456618	SLEEVE BEARING	8756915		
8463514	STEERING CONTROL LEVER SHAFT	8763512	4	
8668636	PLUG	8668636		
8668638	GUARD	8668638	2	CAS MIL-A-11356

Drawing Number	Description	Assembly Number As Tested	Test Number	Materials Primary/ Secondary
8705203	PERISCOPE QUICK RELEASE ASSY.	8705203		
8713396	SLIDE ASSY.	8713396		
8756252	FINAL DRIVE OUTPUT SHAFT ASSY.	8756252		
8756258	ANCHOR TORSION BAR	8756258	4,24	4141 4137H,5145H,8640H,8642H,OT BH301-341
8756363	SUPPORT ARM	11598503	0	FS4145H 4147H,4337H,86B45H,8653H,GR D
8756363	SUPPORT ARM	12268700	16,23	FS4145H 4147H,4337H,86B45H,8653H,GR D
8756377	RIBBED SHOULDER BOLT	12253132		
8756378	RIBBED SHOULDER BOLT	12253132		
8756478	BEARING AND OIL SEAL RETAINER	8756478		
8756491	FINAL DIRVE SPLIENED SHAFT	8756252		
8756494	FINAL DRIVE SPLINED SHAFT PLUG	8756252		
8756497	SPEEDOMETER ADAPTER	8756494		
8756552	DIFFERENTIAL STEERING LEVER	8756552		
8756586	DIFFERENTIAL UNIVERSAL JOINT YOKE	8756586		
8756618	SLEEVE BEARING	0		
8756672	DIRVERS HATCH HINGE	8756672		
8756711	GROVE PULLEY	8756915		
8756850	FILLER CAP COVER	8756850	4	CAS
8756915	GROOVE PULLEY	8756915		
8756970	PLAIN SOLID DISK	10907310	0	
8756972	HATCH COVER HINGE SEGMENT	8756972		
8763159	PIVOT BREAK HOUSING	11660974		
8763251	RIFLE MOUNTING CLIP	8763251		
8763257	CLIP BRACKET	8763251		

Drawing Number	Description	Assembly Number As Tested	Test Number	Materials Primary/ Secondary
8763258	CLIP	8763251		
8763301	FINAL DRIVE UNIVERSAL JOINT ADAPT	8763301		
8763384	TOWING EYE	8763384		
8763447	RIFLE MOUNTING CLIP	8763251		
8763477	DIFFERENTIAL STEERING SHAFT	8763477		
8763494	MACHINE THREAD PLUG	8763494		
8763502	BRACKET AND SPHERICAL BEARING ASS	8763503		
8763503	QUADRANT BRACKET	8163503		
8763512	STEERING CONTROL LEVER	8763512	4	
8763513	STEERING CONTROL LEVER ARM	8763512	4	FS1010-1025
8763514	STEERING CONTROL LEVER SHAFT	8763512	4	TS FS1000-1025 CD
8763515	STEERING CONTROL ARM RETAINER	8763512	4	FS1010-1025 HR
8763518	SEALED SELF-ALIGNING PLAIN BEARIN	8763503		
8763560	SPRING SPOOL	8763560	1	
8921313	ENGINE HAND HOLD COVER	8921313	0	ST SP
8925269	Valve Cover	8925269	4	ST
8925270	DETROIT DIESEL ENG VALVE COVER	8925270	4	ST
10232625	BILGE PUMP ACCESS DOOR ASSY.	10232625	0	
10232628	BILGE PUMP ACCESS DOOR	10232625	0	
10236079	CLEVIS	10236079	0	
10236081	KNOB (CASTING)	10236103	0	
10236083	HANDLE (CASTING)	10236084	0	
10236084	KNOB LOCK HANDLE (MACHINED)	10236084	0	

Drawing Number	Description	Assembly Number As Tested	Test Number	Materials Primary/ Secondary
10236085	REMOTE CONTROL LEVER	10236085	0	
10236096	HOUSING COVER	10236096	0	
10236103	BOLT KNOB (MACHINED)	10236103	0	
10861293	FUELCELL FILLER NECK	10861293		
10861294	NECK FILLER FLANGE	10861293		
10861500	DIFFERENTIAL STEERING SHAFT	8763477		
10861501	LEVER ARM	8763477		
10861503	LEVER ARM	8763477		
10861515	DIFFERENTIAL STEERING SHAFT	10861515		
10861561	HOOK	10861561		
10861607	TOWCABLE HOOK	10861607	7,24	4140H 4142H,ETC
10861641	ACCELERATOR PEDAL LEVER	10932839	0	CS1009-1025
10861642	ACCELERATOR PEDAL	10932839	0	CS A621 OR A622
10861712	MASTER HYDRAULIC BRAKE CYLINDER	10861712		
10861717	VALVE ASSY	10861717		
10863439	BEARING SPACER	12253143	0	
10865580	COVER HATCH HINGE SEGMENT	10865584		
10865854	HATCH COVER HINGE SEGMENT	10865854		
10865921	PLAIN SOLID DISK	10890649		
10865936	EXHAUST HEATER TUBE	10875342	0	TS
10865937	HEATER EXHAUST ELBOW	10875342	0	CAS CLS2
10865985	SHOCK ABSORBER MOUNT	10865985	7,25	4135H 4137H,4140H,ETC
10866040	VEHICLE LIFTING EYE	10866040	4	4140-4145 C38-C42
10866089	FAN DRIVE SHAFT	10866089	0	C137-C1151 IH SPLINE C32-38

List of All Drawings/Parts Inc. Material Specs

Drawing Number	Description	Assembly Number As Tested	Test Number	Materials Primary/ Secondary
10866123	SPINDLE	10866124		ST 4140H 4142H, 8640H, 8659H
10866123	SPINDLE	11598503	0	ST 4140H 4142H, 8640H, 8659H
10866123	SPINDLE	12268700	16,23	4140H 4142,8640H,8650H
10866124	SUPPORT ARM	10866124		
10866131	IDLER WHEEL SPINDLE	1225?143	0	
10866206	STEERING ARM QUADRANT	10866206		
1087468C	CATCH BOLD HANDLE	10874686	7	CST ST CLS 80-50 OR 90-60
1087479?	HOOK AND DAMPER	10874799		
10874930	TRACK ' ' DJUSTER MOUNTING B	10874930	7,24	4140H,ETC
10875330	FINAL DRIVE UNIVERSAL JOINT SPIDE	10875330	7,24	
10875342	HEATER EXHAUST ELBOW	10875342	0	TS & CAS WELDED
10875398	BEARING RETAINER	1	2	AL ST 1340 4137-4145,8640,5145
10875594	SLEEVE SPACER	10875594	7	AL ST 1340 4130,4135,5130,5135,8630H,8635
10885917	STRAINER SCREEN	10885917	2	
10886310	SHAFT	10932839	0	CS 1010-1025
10886450	LATCH HANDLE	10886450	3	
108867'5	AUXILIARY PEDAL	10886715		
10888013	SLEEVE BEARING	1		
10890528	BEARING HOUSING	10890528		
10890648	CARGO HATCH TORQUE BRACKET	10890649	0	
10890649	CARGO HATCH TORQUE BRACKET WELDED	10890649	0	
10907273	TORSION BAR ANCHOR	10907310	0	
10907310	TORSION BAR RETAINER	10907310	0	

Drawing Number	Description	Assembly Number As Tested	Test Number	Materials Primary/ Secondary
10907799	IDLER WHEEL	10907799	3	CS CLS120-95
10911056	SLEEVE BEARING	8763512	4	
10918159	ROAD WHEEL HOUSING SUPPORT	10918160	16	CST GRD115-95 QT ASTM A148
10918160	SUPPORT HOUSING	10918160	23	
10932290	ELECTRICAL INSTALLATION	10932290		
10932551	ADAPTER	10932551	0	1008-1025
10932745	PROPELLER SHAFT	10932745		
10932824	(STEERING CONTROL SHAFT)	10932824	4	
10932838	DOUBLE ANGLE BRACKET	10932839	0	CS1008-1020
10932839	ACCELERATOR CONTROL PEDAL	10932839	0	
10932844	ACCELERATOR CONTROL ARM	10932844		
10932916	ENGINE OIL HOSE OIL	10932916		
10932988	GASKET	10932988		
10942567	SPROCKET CARRIER	10942567	4	CST ST GR105-85 CST ST GR120-95 ASTM A148
10942621	ELECTRICAL INSTALLATION	10942621		
10943071	BATTERY MOUNTING FRAME	10943071	0	
10943072	STEEL CHANNEL	10943071	3	1008-1024
10949503	LOWER TAILGATE LOCK HANDLE	10949503	2	
10949528	RIGHT ENGINE MOUNT ADAPTER	10949529		
10949605	FUEL TANK ACCESS COVER	10949505	3	
10949788	SLIDING WINDOW CHANNEL	10949818	0	1008-1020
10949792	WINDOW LOCK HANDLE	10949818	0	1008-1020
10949818	WINDOW CHANNEL ASSEMBLY	10949818	0	
10950143	OUTER CAB DOOR PANEL		0	

Drawing Number	Description	Assembly Number As Tested	Test Number	Materials Primary/ Secondary
11010703	SCOOP DISC SUBASSY. (REPLACE PART		0	
11069946	BASE PLATE	11069946		
11070018	BOX COVER	10170449		
11070220	GASKET COVER	11070449		
11070350	BUS BAR W1 TO CIRCUIT BREAKER	11070350		
11070354	BUS BAR W1 TO E2	11070354		
11070449	DISTRIBUTION BOX ASSEMBLY COVER	11070449		
11588878	DOOR LATCH	11589281	0	
11589281	TRUNNION ENGINE MOUNT	11589281	0	ND CST CLS5 OR 6 CST ST CLS65-35,70-36,80-40
11598005	AIR CLEANER COVER	11598005		
11598503	TRACK SUSPENSION PIVOT ARM	11598503	0	TEMPER WELD @ 500 *F
11612673	SLIDE LATCH PIN	11612676	2	
11612674	LATCH SLIDE	11612676	2	
11612675	SLIDE LATCH BODY	11612676	2	
11612676	SLIDE LATCH ASSY	11612676	2	
11613007	BALL PLUNGER	11612676	2	
11633395	HELICAL TORSION SPRING	10949818	0	MW SPEC QQ-W-470
11633491	LOOP CLAMP	11633491		
11633894	SLEEVE BEARING	12253143	0	OL16
11634072	INSULATED COVER	11634072		
11640643	UNIVERSAL JOINT SPIDER	11640643		
11660920	TRUNNION	11598503	0	4140H 4142H,4145H,8650H
11660920	TRUNNION	12268700	16,23	4140H 4142H,4145H,8650H

Drawing Number	Description	Assembly Number As Tested	Test Number	Materials Primary/ Secondary
11660974	APIVOT SINGLE DISK BRAKE ASSEMBLY	11660974		
11669238	PROPELLER SHAFT	11669238		
11669358	SUSPENSION ARM	12253578	25	FS4140H-4145H
11669359	GUARD	11669359	3,25	4130H-4140 4340,8630-8640
11669361	BEARING UNIT HOUSING	11669361	2	
11669365	SLEEVE BEARING	12253578	25	OL16
11669366	GUARD	11669366	3,25	4130H-4140 4340,8630-8640
11669367	IDLER WHEEL SPINDLE	12253578	25	FS 4142 F145H,86B45H
11669373	IDLER WHEEL	11669373	3	CST ST GR120-95
11678123	SUPPRESSOR MOUNTING PLATE	11678123	9,10	
11678177	DIFFERENTIAL UNIVERSAL JOINT YOKE	11678177		
11678255	SPROCKET WHEEL	11678255	0	FS 1345H 4340H,4140H-4150,50B44H,50B50HOR 134[illegible] FIH
11699728	AFT BEAM	11699728		
12253130	HUB CAP	12253130	7	
12253131	BEARING UNIT HOUSING	12253132		
12253132	HUB ASSEMBLY	12253132		
12253143	IDLER ARM	12253144	3,18	
12253144	CLEVIS	12253143	0	
12253406	Hatch Cover	12253406	4	
12253425	FAN PULLEY ACCESS COVER	12253425	9,10,11	
12253519	IDLER FLAT PULLEY	12253519	7	
12253531	GROOVED PULLEY	12253531	0	CS 1040-1045
12253535	ADJUSTABLE ROD END BRACKET	12253535		
12253570	OIL FILTER MOUNTING BRACKET	12253570	0	

Drawing Number	Description	Assembly Number As Tested	Test Number	Materials Primary/ Secondary
12253578	IDLER ARM	12253578	2,16,18	
12253646	FILLER CAP COVER	12253646	0	AS CLS 2
12265722	INTERCOM BOX ANGLE BRACKET	12265722	0	
12268684	GROOVED IDLER PULLEY	12268684	0	1010-1025
12268689	SUSPENSION TORSION BAR	12268689	8	
12268692	SHOCK ABSORBER MOUNT	12268692	7	4135H
12268700	ROAD WHEEL ARM ASSEMBLY	12268700	16,23	
12268773	PIPE ELBOW	10875342	0	TS
12268994	AIR INLET HOUSING	12268994		
12269095	GROOVED PULLEY	12269095	0	
12269508	CLIP RETAINER		0	
12276657	ROAD WHEEL SUPPORT HOUSING	12276657	16,23	FS 4130 8630
12292439	MOTOR SUPPORT	12292439	1	
12292441	MOTOR CLAMP	12292441	1	
12294243	VEHICLE LIFTING EYE	12294243	0	FS 4140-4145
12294481	SHIELD	12294481	3	
12294777	FORWARDER HOUSING	12294777	0	
12294924	WIRE SHIELD	12294924	3	
12295281	IDLER SUPPORT ARM SPINDLE	12295281		4140H-4145H 8640H, 4340H
12295282	IDLER BEARING UNIT HOUSING	12295282		
12295290	DUAL SUPPORT ROLLER SPINDLE	12295290		CST ST GR120-95
12295542	RIBBED SHOULDER BOLT		0	
12296932	TRACK SUSPENSION PIVOT ARM ASSY.	12296932		

List of All Drawings/Parts Inc. Material Specs

Drawing Number	Description	Assembly Number As Tested	Test Number	Materials Primary/ Secondary
12296935	ROAD WHEEL HUB ASSY.	12296935		
12297029	TAPERED PIN	12297029		AL ST 4130-4140
12297362	COMM. CONTROL MOUNTING PLAT	12297362	9,10,11	
12298112	SAFETY HANDLE (NEW PART #12317063	12298112	2	
12307265	HATCH HANDLE AND HOOK	12307265	1	
12307270	CONTROL DOOR ANGLE HANDLE	12307270	1	AS 1330 4130 & 1010-1025
12317158	25 MM AMUNITION ACCESS DOOR	12317158		
12328579	SAFETY ANCHOR SHACKLE	12328579		
12328805	IDLER WHEEL ARM	12328805		
12349903	BILGE PUMP STRAINER	12349903		
108990528	Pillow Block	108990525	3	

APPENDIX D

ATMOSPHERIC EMISSION TEST REPORT

INTERNATIONAL
TECHNOLOGY
CORPORATION

ATMOSPHERIC EMISSION TEST REPORT

FLUIDIZED-BED PAINT REMOVAL DEMONSTRATION TESTS RED RIVER ARMY DEPOT, TEXARKANA, TEXAS

by

IT Air Quality Services
11499 Chester Road
Cincinnati, Ohio 45246

Contract No. DAAA15-88-D-0001
Task Order No. 0005
JTN 816004-002

Contracting Officer's Representative
Ms. Carolyn Graham

Project Officer
Mr. Ron Jackson

U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5423

April 1991

Regional Office
11499 Chester Rd. • Cincinnati, Ohio 45246 • 513-782-4700

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FIGURES

TABLES

SECTION 1

INTRODUCTION

1.1 Background

For this task assignment, PEI Associates, Inc. (PEI), under contract to the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), has purchased and installed a Procedyne Corporation fluidized-bed paint stripper (FBPS) at the Red River Army Depot (RRAD) near Texarkana, Texas. The FBPS is a production unit used to remove paint, oils, and greases from metal parts by immersing the parts in a fluidized bed of aluminum oxide granules maintained at temperatures high enough to pyrolyze organic matter. Typical temperatures range from 700° to 1000°F, with residence times in the bed of approximately 1 hour. Usually the bed contains insufficient oxygen to support combustion. Therefore, organic matter on the parts and in the coatings (paints and primers) is pyrolyzed in the FBPS to carbon and carbon monoxide. An in-line gas-fired incinerator burns the carbon monoxide and fluidizing-bed gases. The products of combustion are exhausted through a water venturi scrubber to the atmosphere.

The FBPS is an alternative to solvent-based paint-stripping systems. Solvent-based paint-stripping systems typically use methylene chloride and other chlorinated solvents. The solvents chemically destroy the organic binders in the paint. The remaining coating material is removed with washing action or shotblasting prior to re-coating.

Typically, chemical paint-stripping solvents are toxic and volatile. Methylene chloride, the most commonly used solvent, is especially volatile (boiling point 40°C or 104°F). The chemical paint-stripping process generates sludge consisting of stripped

coatings contaminated with paint-stripper solvents. The sludge is listed as a categorical hazardous waste and must be disposed of as such. PEI and USATHAMA believe that installation of the FBPS will reduce atmospheric releases of stripper compounds (mostly chlorinated solvents) and reduce the volume of hazardous wastes requiring disposal. Therefore, the objective of this test program is to demonstrate that the use of an FBPS will reduce hazardous waste while satisfactorily removing coatings (or assisting removal) and enabling reuse of parts at the RRAD.

1.2 Atmospheric Emission Tests

Atmospheric emission tests were conducted on February 26, 27, and 28, 1991. Testing was performed at the following three locations:

- Afterburner inlet (AI)
- Venturi scrubber inlet (VI)
- Venturi scrubber outlet (VO)

At each location, a Method 5 sampling train, modified to allow collection and analysis of trace metals [total chromium (Cr), cadmium (Cd), lead (Pb), and zinc (Zn)], was used to measure particulate and metals concentrations. In addition, a continuous flame ionization analyzer (FIA) was used to measure total hydrocarbon (THC) concentrations at the AI and VI locations.

Messrs. Bob Ressl and David Pomerantz of PEI coordinated FBPS operations throughout each test period and collected appropriate process samples (scrubber water-bed sand samples). The following report sections detail the results of the emission sampling effort.

SECTION 2

SUMMARY OF TEST RESULTS

This section details the results of the emission test program. No attempt is made to correlate emissions with FBPS operation, although conclusions relative to pollutant removal efficiencies are addressed based on the emission data.

2.1 Sampling Plan

Table 2-1 summarizes test times, parameters, and FBPS operation for this test program. Particulate/multimetals samples were collected simultaneously at the indicated locations for Test Series 1 through 5. Test Series 6 through 8 were conducted at only the AI and VO test locations. Measurements of THC were made primarily at the AI and VI test locations.

The initial test series was conducted for about 120 minutes and the remaining tests were conducted for 60 minutes each.

2.2 Flue Gas Data Summary

Tables 2-2 through 2-4 summarize flue gas conditions at each location.

Prior to each test, U.S. EPA Methods 1A and 2C* were used to measure velocity pressure head and temperatures. These data were then used to set isokinetic sampling rates. Volumetric flow rates are generally expressed in actual cubic feet per minute (acfm) and dry standard cubic feet per minute (dscfm) at 68°F, 29.92 in.Hg, and zero percent moisture.

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* 40 CFR 60, Appendix A, July 1990.

TABLE 2-1. RRAD TEST PLAN

FBPS test No.	Corresponding emission test No.[a]	Date (1991)	Time (24-h)	Type of parts charged	Net wt of charge, lb	Emission parameter: Particulate/metals	Emission parameter: THC[b]
029	AIPM-1 SIPM-1 SOPM-1	2/26	0922-1142	Scrap aluminum	319	√	VI
030	AIPM-2 SIPM-2 SOPM-2	2/26	1426-1535	Cd- and Zn-plated and scrap aluminum	955	√	VI
031	AIPM-3 SIPM-3 SOPM-3	2/27	0806-0914	None	0	√	AI
032	AIPM-4 SIPM-4 SOPM-4	2/27	1034-1139	Scrap aluminum	235	√	AI
033	AIPM-5 SIPM-5 SOPM-5	2/27	1327-1432	Roadarms	996	√	AI
034	AIPM-6[c] SOPM-6	2/28	0800-0905	Cd-plated and scrap aluminum	964	√	AI
035	AIPM-7[c] SOPM-7	2/28	0945-1050	None	0	√	AI
036	AIPM-8[c] SOPM-8	2/28	1128-1253	Roadarms with oil and grease	700	√	AI

[a] AIPM = afterburner inlet, SIPM = venturi inlet, SOPM = venturi outlet.

[b] VI = venturi inlet, AI = afterburner inlet.

[c] Venturi inlet tests not conducted because of glassware breakage and subsequent shortage.

TABLE 2-2. SUMMARY OF FLUE GAS CONDITIONS - AFTERBURNER INLET

Run No.	Date (1991)	Time (24-h)	Volumetric flow rate		Tempera- ture, °F	Mois- ture, %	Composi- tion, %	
			acfm[a]	dscfm[b]			O_2	CO_2
AIPM-1	2/26	0924-1124	521	366	228	7.9	21	0
AIPM-2	2/26	1426-1526	524	348	233	12.4	21	0
AIPM-3	2/27	0806-0906	531	372	281	0.9	21	0
AIPM-4	2/27	1038-1138	499	392	191	2.3	21	0
AIPM-5	2/27	1330-1430	526	341	229	14.6	21	0
AIPM-6	2/28	0800-0900	507	412	168	1.5	21	0
AIPM-7	2/28	0945-1045	519	404	198	1.0	21	0
AIPM-8	2/28	1153-1253	530	395	226	1.4	21	0

[a] acfm = Actual cubic feet per minute.

[b] dscfm = Dry standard cubic feet per minute. Standard conditions are 68°F, 29.92 in.Hg, and zero percent moisture.

TABLE 2-3. SUMMARY OF FLUE GAS CONDITIONS - VENTURI INLET

Run No.	Date (1991)	Time (24-h)	Volumetric flow rate		Tempera- ture, °F	Mois- ture, %	Composi- tion, %	
			acfm[a]	dscfm[b]			O_2	CO_2
SIPM-1	2/26	0923-1123	1082	892	113	9.6	20	1.0
SIPM-2	2/26	1427-1527	1311	1066	116	10.4	20	1.0
SIPM-3	2/27	0807-0907	1276	1058	111	9.1	20	1.0
SIPM-4	2/27	1037-1137	1230	995	116	10.5	20	1.0
SIPM-5	2/27	1329-1429	1280	1002	123	12.5	20	1.0

[a] acfm = Actual cubic feet per minute.

[b] dscfm = Dry standard cubic feet per minute. Standard conditions are 68°F, 29.92 in.Hg, and zero percent moisture.

TABLE 2-4. SUMMARY OF FLUE GAS CONDITIONS - VENTURI OUTLET

Run No.	Date (1991)	Time (24-h)	Volumetric flow rate acfm[a]	dscfm[b]	Temperature, °F	Moisture, %	Composition, % O_2	CO_2
SOPM-1	2/26	0922-1142	915	695	131	15.4	20	1.0
SOPM-2	2/26	1430-1535	982	787	126	11.4	20	1.0
SOPM-3	2/27	0808-0914	974	788	125	10.5	20	1.0
SOPM-4	2/27	1034-1139	920	744	123	11.1	20	1.0
SOPM-5	2/27	1327-1432	963	765	127	11.9	20	1.0
SOPM-6	2/28	0800-0905	980	754	129	13.7	20	1.0
SOPM-7	2/28	0945-1050	983	770	125	12.8	20	1.0
SOPM-8	2/28	1128-1232	961	755	125	12.5	20	1.0

[a] acfm = Actual cubic feet per minute.

[b] dscfm = Dry standard cubic feet per minute. Standard conditions are 68°F, 29.92 in.Hg, and zero percent moisture.

For tests conducted at the AI, flow rates ranged between 499 and 531 acfm, with average gas temperatures ranging between 168° and 281°F. Flue gas moisture content was generally less than 2.5 percent, except in Tests 1, 2, and 5, where moisture contents of 7.9, 12.4, and 14.6 percent, respectively, were measured. Gas composition data showed essentially ambient characteristics, with 21 percent oxygen (O_2) and 0 percent carbon dioxide (CO_2). A Fyrite gas analyzer was used to make these measurements periodically throughout the test program.

Scrubber venturi inlet flow rates ranged between 1082 and 1311 acfm, with an average temperature of 116°F and a moisture content of 10.4 percent. Gas composition data showed an average O_2 content of 20 percent and a CO_2 content of 1.0 percent.

Scrubber venturi outlet flow rates ranged between 915 and 983 acfm, with an average temperature of 126°F. Gas moisture content averaged about 12.4 percent, with O_2 and CO_2 contents of 20 and 1.0 percent, respectively. Since the gas stream appeared saturated and apparently contained water droplets, two moisture determinations were made: the first involved volumetrically determining the amount of water collected during each test and the second involved calculating the moisture content by

using the vapor pressure of water at the measured stack temperature and pressure. The lower value was reported in each case as specified in U.S. EPA Method 4.*

Because the AI and VI test locations did not conform to U.S. EPA sampling location criteria (see Section 5 of this report), the measured flow rates are probably biased high. By comparing scrubber inlet (VI) and outlet (VO) average flow rates, the measurement bias was determined to be about 25 percent. Outlet flow rates measured at the VO location which meets the U.S. EPA sampling location criteria averaged 757 dscfm for eight tests, compared with a five-test average of 1003 dscfm at the VI (i.e., about a 25 percent difference). In summary, the outlet flow rates are considered representative, whereas the gas flow measured at the other two sites is semi-quantitative at best.

2.3 Particulate/Multimetals Test Results

Particulate concentrations reported in Table 2-5 are expressed in grains per dry standard cubic foot (gr/dscf) and milligrams per cubic meter (mg/m^3). Metals concentrations are expressed in micrograms per cubic meter (μg/m^3). Pollutant mass rates are expressed in pounds per hour (lb/h). The product of volumetric gas flow rate and concentration yields the mass rate in lb/h.

Test SOPM-1 (scrubber outlet) is considered nonrepresentative because a scrubber upset occurred during the first 40 minutes of the test. No major problems, either process or sample related, were encountered with any of the remaining tests.

Afterburner inlet particulate concentrations ranged between 0.01 and 0.08 gr/dscf (23.3 and 183 mg/m^3) for the eight tests conducted. Maximum concentrations were observed in Tests 1, 2, 5, and 6, which correspond to the maximum FBPS system loadings (see Table 2-1). Baseline (no parts charged) tests showed particulate concentrations of 0.01 and 0.026 gr/dscf (23 and 59 mg/m^3).

Particulate concentration at the VI ranged between 0.002 and 0.004 gr/dscf (5 and 9.6 mg/m^3). In the five tests in which simultaneous measurements were made

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* 40 CFR 60, Appendix A, July 1990.

TABLE 2-5. SUMMARY OF PARTICULATE AND METALS EMISSIONS

Test No.	Test location	Date (1991)	Time (24-h)	Particulate emissions: Concentration gr/dscf	Particulate emissions: Concentration mg/m^3	Particulate emissions: Mass emission rate, lb/h	Metals emissions: Concentration, µg/m^3 Cd	Cr	Pb	Zn	Metals emissions: Mass emission rate, lb/h Cd	Cr	Pb	Zn
AIPM-1	AB inlet[a]	2/26	0924-1124	0.08	182.8	0.25	89	106	300	723	1.2E-4	1.4E-4	4.1E-4	9.9E-4
SIPM-1	VS inlet[b]	2/26	0923-1123	0.003	9.9	0.024	4.7	9.2	16.2	<2.0[c]	1.6E-5	3.1E-5	5.4E-5	<6.8E-6
SOPM-1	VS outlet[d]	2/26	0922-1142	0.13	297.5	0.80	30	373	574	861	7.9E-5	9.7E-4	1.5E-3	2.2E-3
AIPM-2	AB inlet	2/26	1426-1526	0.06	132.7	0.17	70	267	178	480	9.1E-5	3.5E-4	2.3E-4	6.3E-4
SIPM-2	VS inlet	2/26	1427-1527	0.002	5.5	0.022	8.4	<2	9.1	<4	3.4E-5	<8.7E-6	3.6E-5	<1.4E-5
SOPM-2	VS outlet	2/26	1430-1535	0.007	15.8	0.047	12.4	<4	17.6	<7	3.7E-5	<1.1E-5	5.2E-5	<1.9E-5
AIPM-3	AB inlet	2/27	0806-0906	0.01	23.3	0.033	6.2	<4	57	33	8.6E-6	<4.9E-6	8.0E-5	4.6E-5
SIPM-3	VS inlet	2/27	0807-0907	0.004	9.6	0.038	3.7	<2.2	7.0	<3.6	1.5E-5	<8.6E-6	2.8E-5	<1.4E-5
SOPM-3	VS outlet	2/27	0808-0914	0.004	8.2	0.024	6	<2.8	4.9	<4.7	1.8E-5	<8.4E-6	1.4E-5	<1.4E-5
AIPM-4	AB inlet	2/27	1038-1138	0.027	61.3	0.09	10.6	30.3	71	22.1	1.6E-5	4.4E-5	1.0E-4	3.2E-5
SIPM-4	VS inlet	2/27	1037-1137	0.0039	8.9	0.033	3.2	<2.3	1.5	<3.9	1.2E-5	<8.6E-6	5.7E-6	<1.4E-5
SOPM-4	VS outlet	2/27	1034-1139	0.0037	8.4	0.023	<2.1	<3.2	3.7	<5.3	<5.9E-6	<8.8E-6	1.0E-5	<1.5E-5
AIPM-5	AB inlet	2/27	1330-1430	0.05	114.4	0.15	44.6	134	178	671	5.7E-5	1.7E-4	2.3E-4	8.6E-4
SIPM-5	VS inlet	2/27	1329-1429	0.0022	5.0	0.019	4.4	14.5	9.4	46	1.7E-5	5.4E-5	3.5E-5	1.7E-4
SOPM-5	VS outlet	2/27	1327-1432	0.013	28.8	0.083	2.2	<2.9	10.1	34 5	6.3E-6	<8.2E-6	2.9E-5	9.9E-5
AIPM-6	AB inlet	2/28	0800-0900	0.052	118.8	0.18	64	68.8	200	223	9.9E-5	1.1E-4	3.1E-4	3.4E-4
SOPM-6	VS outlet	2/28	0800-0905	0.0037	8.4	0.024	9.3	<2.9	16.1	4.8	2.6E-5	8.2E-6	4.5E-5	1.4E-5
AIPM-7	AB inlet	2/28	0945-1045	0.026	59.3	0.09	170	80	308	649	2.6E-4	1.2E-4	4.7E-4	9.8E-4
SOPM-7	VS outlet	2/28	0945-1050	0.0028	6.4	0.019	<1.9	10	18.8	14.4	5.5E-6	2.9E-5	5.4E-5	4.2E-5
AIPM-8	AB inlet	2/28	1153-1253	0.017	38.7	0.057	47	10	117	87	6.9E-5	1.5E-5	1.7E-4	1.3E-4
SOPM-8	VS outlet	2/28	1128-1232	0.0040	9.1	0.026	12.4	<3	9.5	13.8	3.5E-5	<8.4E-6	2.7E-5	3.9E-5

[a] Afterburner inlet.

[b] Venturi scrubber inlet.

[c] "Less than" denotes below method detection limit (MDL).

[d] Venturi scrubber outlet. Test SOPM-1 is considered nonrepresentative because of a scrubber upset.

at all three locations, particulate concentration was reduced by more than 85 percent in a comparison of the AI and VI test results.

Particulate concentrations at the VO ranged between 0.003 and 0.013 gr/dscf (6.4 and 28.8 mg/m^3). Corresponding mass emission rates were 0.019 and 0.47 lb/h, respectively. In Tests 2 through 5, VI and VO test results were very similar and, in some cases, showed higher outlet results (Tests 2 and 5). This is believed to be a function of scrubber operation in that no mist elimination system is in place. Visual observation of the system indicated a significant water carryover rate at the outlet test location and resulted in entrained particulate (in the water droplets) being collected at the sampling location.

Emission samples collected at each location were subjected to a metals analysis for Cd, Cr, Pb, and Zn. As reported, all four metals were found in all samples collected at the AI. The highest metals concentrations were observed in Tests 2, 5, 6, and 7. Tests 2, 5, and 6 correspond to the largest FBPS charge weights, and Test 7 was conducted at a baseline (no-load) condition.

As reported, metals concentrations were reduced across the system in close parallel with total particulate reductions.

2.4 Total Hydrocarbon Test Results

Table 2-6 summarizes the THC test results for the test periods indicated. Concentrations are reported in parts per million (ppm) as methane on both a wet and dry basis. The average volumetric flow rates measured at the indicated locations were used to calculate mass emission rates.

No measurements were made at the VO test location because of the high moisture content of the gas stream. The VI data (February 26) show essentially nondetectable THC levels covering Tests 1 and 2. Even though no measurements were made at the VO outlet, it is reasonable to assume that the same nondetectable level of THC would be observed at the VO outlet based on the VI results. After the February 26 tests, the decision was made to monitor exclusively the AI location and no further measurements were made at the VI or VO locations.

TABLE 2-6. SUMMARY OF HYDROCARBON EMISSIONS DATA

Range	Date (1991)	Time (24-h)	THC concentration, ppm Wet	THC concentration, ppm Dry	Average volumetric flow rate, dscfm	THC emission rate, lb/h
			Venturi inlet			
0-500	2/26	1011-1045	7.4[a]	8.3	1003	0.021
0-100		1106-1429	2.5[b]	2.8	1003	0.0070
0-100		1429-1503	4.4	4.9	1003	0.012
0-110		1503-1522	2.5	2.8	1003	0.0070
			Afterburner inlet			
0-100	2/27	0923-1019	3.8	4.0	379	0.0038
0-5000		1019-1105	>5000	>5275	379	4.98
0-500		1105-1135	210	221.5	379	0.21
0-100		1135-1143	53.8	56.8	379	0.054
0-100		1143-1245	31.4	33.1	379	0.031
0-100		1245-1255	49.1	51.8	379	0.049
0-100		1255-1331	32.6	34.4	379	0.032
0-500		1331-1340	>560	>591	379	0.56
0-5000		1340-1346	>2670	>2816	379	2.66
0-100		1346-1430	130.3	137.4	379	0.13
0-100		1430-1445	39.7	41.9	379	0.040
0-100		1445-1539	18.5	19.5	379	0.018
0-500	2/28	0805-0837	>2600	>2743	379	2.59
0-500		0837-0903	71.7	75.6	379	0.071
0-500		0903-0920	40.3	42.5	379	0.040
0-500		0920-0936	29.8	31.4	379	0.030
0-500		0936-1009	19.4	20.5	379	0.019
0-500		1009-1041	12.4	13.1	379	0.012
0-500		1041-1128	10.6	11.2	379	0.011
0-500		1128-1157	>2600	>2743	379	2.59
0-500		1157-1253	83.9	88.5	379	0.084

[a] 0-500 ppm range (detection limit ±10 ppm).

[b] 0-100 ppm range (detection limit ±2 ppm).

The AI data were relatively consistent, with the exception of large THC spikes corresponding to Tests 4, 5, 6, and 8. The duration of each spike is indicated by the corresponding time interval in Table 2-6.

2.5 Process Sample Analytical Results

Table 2-7 summarizes the process sample analytical results. A total of six sand and four water samples collected during the test program were analyzed for the specified metals.

Sand Sample 1 was collected from a randomly selected drum (No. 16864) of the virgin sand used to charge the fluidized bed. Samples 2 and 5 are the cold-bed pre- and post-test samples and Samples 3 and 4 are the hot-bed pre- and post-test samples. Sample 6 is the dust sample collected from the cyclone between the beds and the afterburner.

The water samples were collected as a series of grab samples during the emissions tests. Samples 30 and 34 were taken while cadmium- and zinc-plated parts were being processed in the FBPS, and Sample 32 was collected while aluminum-plated parts were being processed.

TABLE 2-7. PROCESS SAMPLE ANALYTICAL RESULTS

	Metal concentration, µg/g[a]			
Sample ID	Cadmium	Chromium	Lead	Zinc
Sand - 1	ND[b]	9.8	0.7	2.9
Sand - 2	1.7	13	18	16
Sand - 3	5.5	24	23	34
Sand - 4	26.7	14.3	25.9	38.4
Sand - 5	2.8	15	23	22
Sand - 6	40.4	35.1	77.5	161
	Metal concentration, mg/L[c]			
Water - 30	0.004	0.083	ND	0.082
Water - 31	0.002	0.030	0.0041	0.031
Water - 32	ND	0.007	0.0007	0.021
Water - 34	0.007	0.064	ND	0.20

[a] µg/g = Micrograms per gram.

[b] ND = Nondetectable.

[c] mg/L = Milligrams per liter.

SECTION 3

QUALITY ASSURANCE PROCEDURES AND RESULTS

The procedures described in the Quality Assurance Project Plan were followed in all field sampling analyses. The following subsections describe the quality assurance (QA) procedures and the results obtained.

3.1 Field Sampling Quality Assurance

Routine Reference Method quality control (QC) procedures were followed throughout the test program. These included, but were not limited to, the following:

- Calibration of field sampling equipment. Sampling equipment was calibrated according to the procedures of the "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III," EPA 600/4-72-027B, August 1977. The calibration data are summarized in Table 3-1. Calibration guidelines are described in more detail in Appendix E.
- Onsite audits of dry gas meters, thermocouples, and digital indicators (see Appendix B).
- Train configuration and calculation checks.
- Onsite QC checks of the sampling train and leak checks of the pitot tube and Orsat line.
- Use of designated equipment and reagents.

The sampling equipment and procedures met all the guidelines established in the reference methods.

3.2 Continuous Emission Monitor - THC

The following QA procedures pertain to the use of the THC continuous emission monitor (CEM):

TABLE 3-1. FIELD EQUIPMENT CALIBRATION

Equipment	ID No.	Calibrated against	Allowable error[a]	Actual error	Within allowable limits	Comments
Meter box	FT-2	Wet test meter	Y ±0.02 Y ΔH @ ±0.15 (Y ±0.05 Y posttest)	0.004 -0.03 -0.032	Yes Yes Yes	
		Critical orifice	Y ±0.05 Y ΔH @ ±0.15	0.016 -0.09	Yes Yes	Field check Field check
	FT-4	Wet test meter	Y ±0.02 Y ΔH @ ±0.15 (Y ±0.05 Y posttest)	0.001 0.03 -0.001	Yes Yes Yes	
		Critical orifice	Y ±0.05 Y ΔH @ ±0.15	0.016 -0.15	Yes Yes	Field check Field check
	FT-11	Wet test meter	Y ±0.02 Y ΔH @ ±0.15 (Y ±0.05 Y posttest)	0.001 0.02 0.002	Yes Yes Yes	
		Critical orifice	Y ±0.05 Y ΔH @ ±0.15	-0.010 -0.05	Yes Yes	Field check Field check
Pitot tube	501 140 107	Geometric specifications	b	b b b	Yes Yes Yes	
	501 140 107	Inspection	No visible damage	No visible damage No visible damage No visible damage	Yes Yes Yes	Field check Field check Field check

(continued)

TABLE 3-1 (continued)

Equipment	ID No.	Calibrated against	Allowable error[a]	Actual error	Within allowable limits	Comments
Digital indicator	FT-2	Millivolt signal	±0.5%	0.0-0.35%	Yes	Range of values
	FT-4		±0.5%	0.0-0.45%	Yes	Range of values
	FT-11		±0.5%	0.0-0.2%	Yes	Range of values
Stack thermocouple	271	ASTM-3F thermometer	±2°F	+1°F	Yes	
Impinger thermocouple	I-2	ASTM-3F thermometer	±2°F	+1°F	Yes	
	I-5		±2°F	+1°F	Yes	
	I-32		±2°F	+1°F	Yes	
Dry gas thermometer	FT-2		±5°F	+2°F	Yes	Inlet
				+2°F	Yes	Outlet
	FT-4			+1°F	Yes	Inlet
				0°F	Yes	Outlet
	FT-11			+1°F	Yes	Inlet
				+1°F	Yes	Outlet
Balance	Mettler Electronic	Type-S weights	±0.5 g	0 g	Yes	
Glass probe nozzles	3-109(SS)	Caliper	±0.004 in.	0.001 in.	Yes	
	VSO		±0.004 in.	0.001 in.	Yes	
	VSI		±0.004 in.	0.002 in.	Yes	
Barometer	414	Hg in glass	±0.05 in.Hg	+0.02 in.Hg	Yes	

[a] As recommended in Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III. Stationary Source Specific Methods. EPA-600/4-77-027b. August 1977.

[b] See Appendix E.

- Use of designated sampling equipment and procedures. The CEM met all performance requirements of U.S. EPA Method 25A. All components in the sampling system were either 316 stainless steel (probes) or Teflon (sampling line and pump diaphragms).

- System leak checks and integrity checks. Prior to the start of the first test, the entire sampling system from the probe to the analyzer inlet was leak-checked by plugging the probe inlet and evacuating the system to 15 in.Hg. The vacuum was observed for 5 minutes to ensure that the system was leak-free.

- System integrity and bias were measured by injecting calibration gases through a three-way valve at the probe outlet and comparing the response obtained with the response obtained when the gas was introduced directly to the analyzer. System integrity test results are listed on the data sheets in Appendix B. System bias in all cases was less than 2 percent of scale.

- Pre- and post-test calibrations. At the beginning and end of each test day, the analyzer was calibrated with three standards in the analytical range and zero nitrogen. The calibration data were reduced by linear regression analysis and the linear equations were used for data reduction. Calibration data are summarized in Table 3-2. Copies of the strip charts are contained in Appendix B.

TABLE 3-2. THC MONITOR QA/QC RESULTS

Monitor	Date (1991)	Calibration error, % of span[a]	Drift, % of span[b]	Correlation coefficient
THC	2/25	0.25	-	0.9999
THC	2/26	0.15	0.12	0.9999
THC	2/27	0.16	1.20	0.9999
THC	2/28	0.16	1.73	0.9999

[a] Calibration error = $\frac{\text{(Cal. gas conc. - conc. predicted)}}{\text{Span value}} \times 100.$

Calibration error is average value from four calibration gases.

[b] Drift = $\frac{\text{(Posttest cal. response - initial cal. response)}}{\text{Span value}} \times 100.$

Drift error is average value from four calibration gases.

NOTE: Calibration error and drift checks were all within the Method 25A limits.

3.3 Analytical Quality Assurance

The laboratory QA procedures outlined in the Quality Assurance Project Plan were followed for each type of analysis.

The QC procedures to be used in the sample analyses in this test program included, but were not limited to, the following:

- Use of designated analytical equipment and experienced laboratory personnel.
- Internal and external audits to ensure accuracy in sampling and analysis.
- Reagent, filter, and field blanks to determine blank levels.
- Spiked samples to determine the effect of sample handling and the matrix effect.
- Duplicate analysis of selected samples.

Particulate

As a check of the gravimetric analytical procedures, a blank filter and reagent (acetone) were analyzed in a manner similar to that used for actual field sampling. Table 3-3 summarizes the particulate blank data. The blank corrections were applied to the particulate data.

TABLE 3-3. FILTER AND REAGENT BLANK ANALYSIS DATA

Sample type	ITAS Lab No.	Tare weight, mg	Average gross weight, mg	Net difference, mg
Filter (9070094)	X10305509-A	468.2	469.1	0.9
Acetone	X10305509-B	107,373.9	107,376.0	2.1 mg (0.0077 mg/g)

Metals

Quality assurance for metals (Cr, Cd, Pb, Zn) included filter reagent blank data, duplicate analysis (Pb only), and Standard Reference Solution (SRS) analysis. These data are summarized in Table 3-4. Method Detection Limit (MDL) data for the stack emission samples are summarized in Table 3-5.

TABLE 3-4. METALS QA/QC DATA
(EMISSION SAMPLES)

Metal	Filter and HNO_3/H_2O_2 blank data, µg	SRS data: Theoretical value, mg/L	SRS data: Percent recovery (duplicate)
Chromium	9.6	1	85.6, 87.8
Cadmium	2.4	1	86.7, 95.8
Lead	2.4	0.75	92.0, 84.4
Zinc	58	1	80.4, 82.9

TABLE 3-5. METHOD DETECTION LIMIT DATA
(total µg)

Metal	Afterburner inlet	Venturi scrubber inlet	Venturi scrubber outlet
Chromium	3	3	3
Cadmium	2	2	2
Lead	11	0.6	0.6
Zinc	5	5	5

As indicated, the lead analyses were performed in duplicate; laboratory report values (Appendix C) represent the average of the duplicate analysis.

Metals blank corrections were applied to all reported data using the blank values summarized in Table 3-4. The reported SRS data are within the guidelines established for each metal analyte.

Process Samples

Quality assurance for the process samples included SRS analysis and duplicate analysis for lead. The percent recovery data for all metals were within the guidelines specified in the analytical methods. These data are contained in Appendix C.

SECTION 4

FLUIDIZED-BED PAINT STRIPPER OPERATION

Table 4-1 summarizes the FBPS operation and type of emission tests conducted during this test program.

TABLE 4-1. FBPS OPERATION AND TYPE OF EMISSION TESTS

			Emission test part				
Test No.	Date (1991)	FBPS test No.	After-burner inlet	VI between wet cap and scrubber	VO atmospheric emissions	Types of parts charged	Net wt. of charge, lb
1	2/26	029	√	√	√	Scrap aluminum	319
2	2/26	030	√	√	√	Cd- and Zn-plated and scrap aluminum	956
3	2/27	031	√	√	√	None	0
4	2/27	032	√	√	√	Scrap aluminum	235
5	2/27	033	√	√	√	Roadarms	996
6	2/28	034	√	a	√	Cd-plated and scrap aluminum	964
7	2/28	035	√	a	√	None	0
8	2/28	036	√	a	√	Roadarms with oil and grease	700

[a] Afterburner inlet and scrubber outlet tests only.

On February 26, 1991, the first emission test was conducted with painted aluminum parts processed in the FBPS. In the second emissions test, Cd-plated, Zn-plated, and painted parts were processed in the FBPS. Two painted parts had been weighed and marked before and after the test to determine the amount of paint removed. A composite wet cap/scrubber water sample was collected during this test. The plated parts from the second test were sent to be replated.

On February 27, three 1-hour emission tests were run. The first run (Test 3) was without any parts loaded in the hot bed. A water sample was collected during this test. For the second run (Test 4), the unit was loaded with painted aluminum parts. water sample was also collected during this test. For the third run (Test 5), Bradley Roadarms were processed in the FBPS. These parts had a combination of paint and grease.

On February 28, three additional 1-hour emission test runs were performed. Test 6 was run with Cd- and Zn-plated parts and painted parts in the FBPS. Three of the Cd-plated parts had been marked and weighed before and after plating, and after the test run. Also, five steel plates were included with the test part. The plates had been sandblasted clean, and their thickness measured, weighed, plated, and measured again. After the test run, the thickness and weight of each plate were again checked. A water sample was collected during the test.

The seventh emission test was conducted with no parts in the hot bed. For the eighth test, the parts baskets were loaded with painted M113 Roadarms. To these were added an additional 4.5 ounces of oil and 6.75 ounces of grease, simulating typical grease and oil loads. This test run was performed to correlate the hydrocarbon emissions with the amount of hydrocarbon in the charge.

Several representative plated parts were measured and weighed to determine an average area-to-weight ratio for calculating the amount of plating on the miscellaneous steel parts. After the eighth test was run, posttest hot-bed and cold-bed sand samples and a cyclone dust sample were collected.

SECTION 5

SAMPLING LOCATIONS AND TEST METHODS USED

Figure 5-1 depicts the FBPS unit and sampling locations used in this test program. At the VO, two sampling ports 90 degrees off-center were located more than 13 duct diameters from both the nearest upstream and downstream disturbances in the 9-in.-inside-diameter (i.d.) round duct. A total of eight sampling points, four per port, were used to traverse the cross-sectional area of the duct. U.S. EPA Methods 1A and 2C were used to measure volumetric gas flow rates at each location.* Velocity heads and temperature were measured at each point prior to testing. These data were then used to set isokinetic sampling rates at each point because the pitot tube and thermocouple are not attached to the sampling probe when small (less than 12-in.-i.d.) ducts are measured. Between-test velocity measurements varied less than 10 percent. The initial test at the VO was 105 minutes in duration. All remaining tests were 60 minutes in duration (7.5 minutes per point).

At the VI, only one sampling port was available for use in this study. The geometric configuration of the ductwork and surrounding equipment precluded a multiport traverse at this location. A total of six sampling points were used to measure volumetric flow rates in the 6-in.-i.d. round duct. This single port was located approximately 5 duct diameters downstream and 3 duct diameters upstream from the nearest flow disturbances.

These same points were used to traverse the cross-sectional area of the duct. The initial test was 120 minutes in duration (20 minutes per point) and the remaining

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* 40 CFR 60, Appendix A, July 1990.

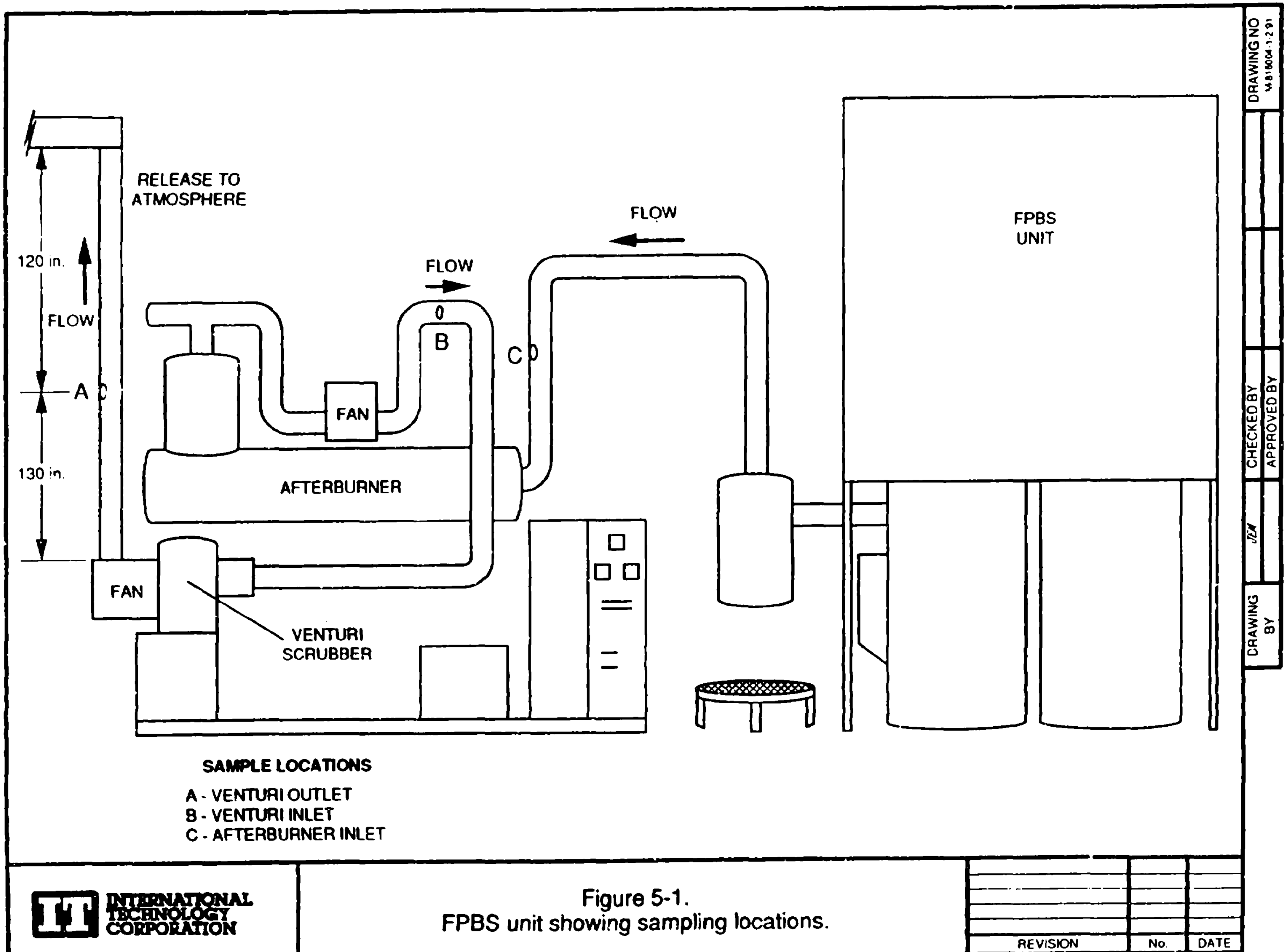

Figure 5-1.
FPBS unit showing sampling locations.

tests were 60 minutes in duration (10 minutes per point). Once again, between-test flow measurements varied less than 10 percent.

The AI test location was similar to that of the VI location in that only one port was available for access to the gas stream. In addition, because the port coupling extended from the outside duct wall into the stainless steel round duct, an accurate inside diameter measurement was impractical. Therefore, a nominal diameter of 5 in. (based on design specifications) was used in all flow-rate calculations. Samples from this location were collected isokinetically at a single point in the duct. The initial test was conducted for 120 minutes, and the remaining seven tests conducted for 60 minutes. Gas compositions (O_2 and CO_2) were measured at each location by a Fyrite gas analyzer.

The following subsections briefly describe the sampling methods used. Detailed descriptions are contained in Appendix D.

5.1 Particulate/Metals

The multimetals/particulate procedures follow those in U.S. EPA's "Methodology for the Determination of Trace Metal Emissions From Stationary Source Combustion Processes."* The sampling train was a Method 5 train with two impingers containing 5 percent nitric acid (HNO_3)/10 percent hydrogen peroxide (H_2O_2) solution. The train uses a quartz fiber filter and a borosilicate glass sampling nozzle to minimize potential blank contamination. Samples were analyzed first for filterable particulate by U.S. EPA Method 5** procedures and then for the specified metals (chromium, cadmium, lead, and zinc) by using both atomic absorption (AA) and inductively coupled argon spectroscopy (ICAS) analysis techniques.

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* Methodology for Determination of Trace Metal Emissions From Stationary Source Combustion Processes, July 1988.

** 40 CFR 60, Appendix A, July 1990.

5.2 Total Hydrocarbons

A Beckman Model 402 continuous-flame ionization analyzer was used to measure THC concentration per Method 25A. The analyzer pump, particulate filter, and detector are housed in a temperature-controlled oven, which is maintained at 300°F for this test.

The monitor was assembled and calibrated per method specifications. The system sampling probe was located at the centroid of each sampling duct, and sampling was conducted successively at the AI and VI test locations.

APPENDIX A

COMPUTER PRINTOUTS AND EXAMPLE CALCULATIONS

Nomenclature and Dimensions

A_n = Cross-sectional area of nozzle, ft^2

A_s = Cross-sectional area of stack, ft^2

B_{ws} = Proportion by volume of water vapor in the gas stream, dimensionless

C_p = Pitot tube coefficient, dimensionless

C_s = Concentration of pollutant in stack gas - grains per dry standard cubic foot, gr/dscf

%C = Percent of carbon by weight, dry basis

%CO = Percent of carbon monoxide by volume, dry basis

$\%CO_2$ = Percent of carbon dioxide by volume, dry basis

D_n = Sampling nozzle diameter, inches

D_s = Stack diameter, inches

F = Factor representing a ratio of the volume of dry flue gases generated to the calorific value of the fuel combusted, expressed as dry standard cubic feet per million Btu of heat input, dscf/10^6 Btu

GCV = Gross calorific value of the fuel combusted on a dry basis, Btu/lb

%H = Percent of hydrogen by weight, dry basis

ΔH = Average pressure drop across the sampling meter flow orifice - inches of water, in. H_2O

HHV = Higher heating value on an as-received basis, Btu/lb

%ISO = Percent of isokinetic sampling

L_a = Maximum acceptable leakage rate for either a pretest leak check of for a leak check following a component change; equal to 0.020 cubic foot per minute of 4% of the average sampling rate, whichever is less

M_d = Dry molecular weight, lb/lb-mole

m_f = fuel firing rate (measured coal to boiler), lb of coal per hour

M_n = Total amount of pollutant matter collected - milligrams, mg

M_s = Molecular weight of stack gas (wet basis), lb/lb-mole

%N = Percent of nitrogen by weight, dry basis

(continued)

Nomenclature and Dimensions

$\%N_2$ = Percent of nitrogen by volume, dry basis

$\%O$ = Percent of oxygen by weight, dry basis

$\%O_2$ = Percent of oxygen by volume, dry basis

ΔP = Velocity head of stack gas - inches of water, in.H_2O

P_{bar} = Barometric pressure - inches of mercury, in.Hg

P_{stat} = (also P_{si}) Static stack gas pressure - inches of water, in.H_2O

P_s = Absolute stack gas pressure - inches of mercury, in.Hg

P_{std} = Gas pressure at standard conditions - 29.92 inches of mercury, in.Hg

pmr = Pollutant matter emission rate - pounds per hour, lb/h

Q_H = Total heat input - million Btu per hour, 10^6 Btu/h

Q_s = Volumetric flow rate - wet basis at stack conditions - actual cubic feet per minute, acfm

Q_{std} = Volumetric flow rate - dry basis at standard conditions - dry standard cubic feet per minute, dscfm

°R = degrees Rankine = degrees Fahrenheit + 460, °F + 460

$\%S$ = Percent of sulfur by weight, dry basis

T_m = Average temperature of dry gas meter, °R

T_s = Average temperature of stack gas, °R

T_{std} = Temperature at standard conditions, 528 °R

V_{lc} = Total volume of liquid collected in impingers and silica gel, ml

V_m = Volume of dry gas sampled at meter conditions - cubic feet, ft^3

V_{mstd} = Volume of dry gas sampled at standard conditions - cubic feet, ft^3

V_s = Average stack gas velocity at stack conditions - feet per second, ft/s

V_{wstd} = Volume of water vapor at standard conditions - cubic feet, ft^3

Y = Dry gas meter calibration correction factor

θ = Total sampling time, minutes

Example Calculations for Pollutant Emissions

1. Volume of dry gas samples corrected to standard conditions. Note: Vm must be corrected for leakage if any leakage rates exceed La.

$$Vmstd = 17.647 \times Vm \times Y\left[\frac{Pbar + \frac{\Delta H}{13.6}}{Tm}\right]$$

2. Volume of water vapor at standard conditions, ft^3.

$$Vwstd = 0.04707 \times Vlc$$

3. Moisture content in stack gas.

$$Bws = \frac{Vwstd}{Vwstd + Vmstd}$$

4. Dry molecular weight of stack gas.

$$Md = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$

5. Molecular weight of stack gas.

$$Ms = Md(1 - Bws) + 18Bws$$

6. Stack velocity at stack conditions, ft/s.

$$Vs = (85.49)(Cp)\left(avg\sqrt{\Delta P}\right)\sqrt{\frac{Ts}{(Ps)(Ms)}}$$

7. Stack gas volumetric flow rate at stack conditions, cfm. Note: As = square feet.

$$Qs = 60 \times Vs \times As$$

8. Dry stack gas volumetric flow rate at standard conditions, cfm.

$$Qstd = (17.647)(Qs)\left(\frac{Ps}{Ts}\right)(1 - Bws)$$

9. Concentration in micrograms per cubic meter, $\mu g/m^3$

$$Cs = (35.315)\left(\frac{Mn}{Vmstd}\right)$$

(continued)

10. Pollutant mass emission rate, lb/h.

$$pmr = Cs \times \left(6.243 \times 10^{-11}\right) \times Qstd \times 60$$

11. Isokinetic variation, %

$$ISO = \frac{(100)(Ts)\left[(0.0002669\ Vlc) + \left(\frac{Vm}{Tm}\right)(Y)\left(Pbar + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\varnothing)(Vs)(Ps)(An)}$$

CORRECTION FACTORS

$$17.647 = \left(\frac{Tstd}{Pstd}\right)$$

$$0.04707 = \left(\frac{ft^3}{ml}\right)$$

0.44 = molecular weight of CO_2/100

0.32 = molecular weight of O_2/100

0.28 = molecular weight of N_2/100

18 = molecular weight of water (H_2O)

$$85.49 = \left[\frac{(lb/lb-mole)(in.Hg)}{(^\circ R)(in.H_2O)}\right]^{\frac{1}{2}}$$

0.01543 = grains per milligram (gr/mg)

$$0.002669 = \frac{(in.Hg.)(ft^3)}{(ml)(^\circ R)}$$

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

FIELD DATA

Plant: **R.R.A.D. Texarkana**
Sampling location: **AB Inlet**
Test time (start-stop): **0924-1124**

Date: **2/28/91**
Run number: **AIPM-1**

Sample type: **Part./Metals**
Bar. press. (in. Hg): **30.06**
Static press. (in. H2O): **-4.100**
Filter number(s): **9070076**
Stack inside dia. (in.): **5.00**
Pitot tube coeff.: **0.84**
Total H2O collected (ml): **115.8**
% O2 by volume (dry): **21.0**

Volume correction (cu. ft.): **0.000**
Meter calibration factor: **0.980**
Data interval (min.): **20.0**
Nozzle dia. (in.): **0.194**
Meter box number: **FT-11**
Number of traverse points: **6**
% CO2 by volume (dry): **0.0**
% CO by volume (dry): **0.0**

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	Dry gas meter temp. (°F) outlet
0.0	763.179					
20.0	774.160	0.950	0.98	192	70	70
40.0	785.000	0.950	0.94	221	74	71
60.0	795.890	0.950	0.94	250	80	74
80.0	805.600	0.950	0.89	269	83	76
100.0	817.360	0.950	0.95	229	85	77
120.0	828.631	0.950	0.94	208	85	78
120.0	**65.452**	**0.950**	**0.94**	**228**	**80**	**74**

NW 3/7/91

Validated 3/7/91

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

FIELD DATA

Plant: **R.R.A.D. Texarkana**
Sampling location: **AB Inlet**
Test time (start-stop): **1426-1526**

Date: **2/26/91**
Run number: **AIPM-2**

Sample type: **Part./Metals**
Bar. press. (in. Hg): **30.06**
Static press. (in. H2O): **-4.100**
Filter number(s): **9070092**
Stack inside dia. (in.): **5.00**
Pitot tube coeff.: **0.84**
Total H2O collected (ml): **95.5**
% O2 by volume (dry): **21.0**

Volume correction (cu. ft.): **0.000**
Meter calibration factor: **0.980**
Data interval (min.): **10.0**
Nozzle dia. (in.): **0.194**
Meter box number: **FT-11**
Number of traverse points: **6**
% CO2 by volume (dry): **0.0**
% CO by volume (dry): **0.0**

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	outlet
0.0	831.237					
10.0	837.010	0.940	0.97	203	77	76
20.0	842.900	0.940	0.97	203	78	77
30.0	847.810	0.940	0.94	227	80	78
40.0	853.640	0.940	0.92	240	82	78
50.0	858.800	0.940	0.93	258	84	79
60.0	864.124	0.940	0.89	268	85	79
60.0	**32.887**	**0.940**	**0.94**	**233**	**81**	**78**

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3-7-91

FIELD DATA

Plant: R.R.A.D. Texarkana
Sampling location: AB Inlet
Test time (start-stop): 0806-0906

Date: 2/27/91
Run number: AIPM-3

Sample type: Part./Metals
Bar. press. (in. Hg): 29.97
Static press. (in. H20): -4.100
Filter number(s): 9070052
Stack inside dia. (in.): 5.00
Pitot tube coeff.: 0.84
Total H2O collected (ml): 5.9
% O2 by volume (dry): 21.0

Volume correction (cu. ft.): 0.000
Meter calibration factor: 0.980
Data interval (min.): 10.0
Nozzle dia. (in.): 0.194
Meter box number: FT-11
Number of traverse points: 6
% CO2 by volume (dry): 0.0
% CO by volume (dry): 0.0

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F)	
					inlet	outlet
0.0	865.797					
10.0	871.000	0.940	0.86	275	72	71
20.0	876.080	0.940	0.86	279	72	72
30.0	881.207	0.940	0.86	281	74	72
40.0	886.480	0.940	0.86	283	78	73
50.0	891.740	0.940	0.86	285	80	74
60.0	896.902	0.940	0.86	285	82	75
60.0	**31.105**	**0.940**	**0.86**	**281**	**76**	**73**

MW 3/7/91

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

TEST RESULTS

Plant: **R.R.A.D. Texarkana**
Sampling location: **AB Inlet**

			Test date(s):	2/26/91	2/26/91	2/27/91	
					Run Numbers		
				AIPM-1	AIPM-2	AIPM-3	AVERAGE
Θ	Net time of test (min)	....		120.0	60.0	60.0	
NP	Net sampling points	....		6	6	6	
Y	Meter calibration factor	....		0.980	0.980	0.980	
Dn	Sampling nozzle diameter (in)	....		0.194	0.194	0.194	
Cp	Pitot tube coefficient	....		0.84	0.84	0.84	
ΔH	Average orifice pressure drop (in. H2O)	....		0.94	0.94	0.86	0.91
Vm	Volume of dry gas sampled at meter conditions (cu. ft.)	....		65.452	32.887	31.105	43.148
Tm	Average gas meter temperature (°F)	....		76.9	79.4	74.6	77.0
Vmstd	Volume of dry gas sampled at standard conditions (scf)	....		63.518	31.767	30.221	41.836
Vlc	Total H2O collected in impingers and silica gel (ml)	....		115.8	95.5	5.9	72.4
Vwstd	Volume of water vapor at standard conditions (scf)	....		5.451	4.495	0.278	3.408
Bws	Percent moisture by volume, as measured	....		7.90	12.40	0.91	7.07
	Percent moisture by volume, at saturation	....		100.00	100.00	100.00	100.00
	Percent moisture by volume, used in calculations	....		7.90	12.40	0.91	7.07
Fmd	Mole fraction of dry gas	....		0.921	0.876	0.991	0.929
%CO2	Percent CO2 by volume (dry)	....		0.0	0.0	0.0	0.0
%O2	Percent O2 by volume (dry)	....		21.0	21.0	21.0	21.0
%CO	Percent CO by volume (dry)	....		0.0	0.0	0.0	0.0
%N2	Percent N2 by volume (dry)	....		79.0	79.0	79.0	79.0
Md	Molecular weight - dry stack gas	....		28.84	28.84	28.84	28.84
Ms	Molecular weight - stack gas	....		27.98	27.50	28.74	28.07
Pbar	Barometric pressure (in. Hg)	....		30.06	30.06	29.97	30.03
Pst	Static pressure of stack gas (in. H2O)	....		-4.100	-4.100	-4.100	-4.100
Ps	Stack pressure - absolute (in. Hg)	....		29.76	29.76	29.67	29.73
Ts	Average stack gas temperature (°F)	....		228.2	233.2	281.3	247.6

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/8/91

TEST RESULTS

Plant: **R.R.A.D. Texarkana** Test date(s): 2/26/91 2/26/91 2/27/91
Sampling location: **AB Inlet**

			Run Numbers AIPM-1	AIPM-2	AIPM-3	AVERAGE
Vh	Average square root of velocity head (in. H2O)	....	0.9747	0.9695	0.9695	**0.9713**
Vs	Average stack gas velocity (feet/sec.)	....	63.63	64.08	64.92	**64.21**
As	Stack area (sq. in.)	....	19.6	19.6	19.6	**19.6**
Qs	Actual stack flow rate (acfm)	....	521	524	531	**525**
Qsstd	Stack flow rate - dry (scfm)	....	366	348	372	**362**
ISO	Percent isokinetic	....	96.1	101.1	90.0	**95.7**

				AIPM-1	AIPM-2	AIPM-3	AVERAGE
		Mass of pollutant	=	328.9	118.7	20.0	
		If below detection li[illegible] replace 0 with 1.		0	0	0	
Mn	**Particulate**	**mass**	mg	**328.9**	**118.7**	**20.0**	
Cs	**Particulate**	**con[illegible]on**	gr/dscf	7.990E-02	5.765E-02	1.021E-02	**4.925E-02**
Pmr	**Particulate**	**emission rate**	lb/h	2.505E-01	1.720E-01	3.253E-02	**1.517E-01**
		Mass of pollutant	=	160.0	63.0	5.3	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**Cadmium**	**mass**	μg	**160.0**	**63.0**	**5.3**	
Cs	**Cadmium**	**concentration**	μg/m3	**88.956**	**70.035**	**6.193**	**55.061**
Pmr	**Cadmium**	**emission rate**	lb/h	**1.219E-04**	**9.126E-05**	**8.621E-06**	**7.392E-05**
		Mass of pollutant	=	190.0	240.4	3.0	
		If below detection limits, replace 0 with 1.		0	0	1	
Mn	**Chromium**	**mass**	μg	**190.0**	**240.4**	**<3.0**	
Cs	**Chromium**	**concentration**	μg/m3	**105.635**	**267.245**	**<3.503**	**125.462**
Pmr	**Chromium**	**emission rate**	lb/h	**1.447E-04**	**3.483E-04**	**<4.880E-06**	**1.660E-04**

bjk ✓
4/10/91

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/8/91

TEST RESULTS

Plant: **R.R.A.D. Texarkana** Test date(s): 2/26/91 2/26/91 2/27/91
Sampling location: **AB Inlet**

				Run Numbers			
				AIPM-1	AIPM-2	AIPM-3	AVERAGE
		Mass of pollutant	=	1300.0	432.0	28.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**Zinc**	**mass**	μg	**1300.0**	**432.0**	**28.0**	
Cs	**Zinc**	**concentration**	μg/m3	**722.768**	**480.241**	**32.719**	**411.909**
Pmr	**Zinc**	**emission rate**	lb/h	**9.903E-04**	**6.258E-04**	**4.554E-05**	**5.539E-04**
		Mass of pollutant	=	540.0	160.0	49.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**Lead**	**mass**	μg	**540.0**	**160.0**	**49.0**	
Cs	**Lead**	**concentration**	μg/m3	**300.227**	**177.867**	**57.258**	**178.451**
Pmr	**Lead**	**emission rate**	lb/h	**4.114E-04**	**2.318E-04**	**7.970E-05**	**2.409E-04**
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**<pollutant>**	**mass**	**mg**	**0.0**	**0.0**	**0.0**	
Cs	**<pollutant>**	**concentration**	**gr/dscf**	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**
Pmr	**<pollutant>**	**emission rate**	lb/h	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1		0	0	0	
Mn	**<pollutant>**	**mass**	**mg**	**0.0**	**0.0**	**0.0**	
Cs	**<pollutant>**	**concentration**	**gr/dscf**	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**
Pmr	**<pollutant>**	**emission rate**	lb/h	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**<pollutant>**	**mass**	**mg**	**0.0**	**0.0**	**0.0**	
Cs	**<pollutant>**	**concentration**	**gr/dscf**	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**
Pmr	**<pollutant>**	**emission rate**	lb/h	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**

OJK ✓
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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

FIELD DATA

Plant: **R.R.A.D. Texarkana**
Sampling location: **Afterburner Inlet**
Test time (start-stop): **1038-1138**

Date: **2/27/91**
Run number: **AIPM-4**

Sample type: **Part./Metals**
Bar. press. (in. Hg): **29.97**
Static press. (in. H20): **-4.100**
Filter number(s): **9070045**
Stack inside dia. (in.): **5.00**
Pitot tube coeff.: **0.84**
Total H2O collected (ml): **16.1**
% O2 by volume (dry): **21.0**

Volume correction (cu. ft.): **0.000**
Meter calibration factor: **0.980**
Data interval (min.): **10.0**
Nozzle dia. (in.): **0.194**
Meter box number: **FT-11**
Number of traverse points: **6**
% CO2 by volume (dry): **0.0**
% CO by volume (dry): **0.0**

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	outlet
0.0	897.928					
10.0	903.340	0.940	1.06	146	76	76
20.0	908.800	0.940	1.02	168	77	76
30.0	914.400	0.940	0.98	192	79	76
40.0	919.800	0.940	0.96	210	81	77
50.0	925.500	0.940	0.96	214	81	77
60.0	931.038	0.940	0.96	216	82	78
60.0	**33.110**	**0.940**	**0.99**	**191**	**79**	**77**

MW 3/7/91

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

FIELD DATA

Plant: R.R.A.D. Texarkana
Sampling location: Afterburner Inlet
Test time (start-stop): 1330-1430

Date: 2/27/91
Run number: AIPM-5

Sample type: Part./Metals
Bar. press. (in. Hg): 29.97
Static press. (in. H20): -4.100
Filter number(s): 9010412
Stack inside dia. (in.): 5.00
Pitot tube coeff.: 0.84
Total H2O collected (ml): 114.8
% O2 by volume (dry): 21.0

Volume correction (cu. ft.): 0.000
Meter calibration factor: 0.980
Data interval (min.): 10.0
Nozzle dia. (in.): 0.194
Meter box number: FT-11
Number of traverse points: 6
% CO2 by volume (dry): 0.0
% CO by volume (dry): 0.0

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F)	
					inlet	outlet
0.0	931.815					
10.0	937.440	0.940	1.01	176	78	77
20.0	942.940	0.940	0.97	205	78	77
30.0	948.400	0.940	0.94	228	80	78
40.0	953.820	0.940	0.91	246	82	79
50.0	959.400	0.940	0.90	256	84	80
60.0	964.720	0.940	0.90	262	85	80
60.0	**32.905**	**0.940**	**0.94**	**229**	**81**	**79**

3/7/91

Validated 3/7/91

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

FIELD DATA

Plant: R.R.A.D. Texarkana
Sampling location: Afterburner Inlet
Test time (start-stop): 0800-0900

Date: 2/28/91
Run number: AIPM-6

Sample type: Part./Metals
Bar. press. (in. Hg): 29.75
Static press. (in. H20): -5.300
Filter number(s): 9010487
Stack inside dia. (in.): 5.00
Pitot tube coeff.: 0.84
Total H2O collected (ml): 10.9
% O2 by volume (dry): 21.0

Volume correction (cu. ft.): 0.000
Meter calibration factor: 0.980
Data interval (min.): 10.0
Nozzle dia. (in.): 0.194
Meter box number: FT-11
Number of traverse points: 6
% CO2 by volume (dry): 0.0
% CO by volume (dry): 0.0

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	Dry gas meter temp. (°F) outlet
0.0	965.043					
10.0	970.760	1.000	1.02	200	73	72
20.0	976.700	1.000	1.12	141	73	72
30.0	982.370	1.000	1.08	159	74	72
40.0	988.420	1.000	1.07	168	79	73
50.0	994.000	1.000	1.07	171	79	74
60.0	999.855	1.000	1.07	170	81	75
60.0	**34.812**	**1.000**	**1.07**	**168**	**77**	**73**

KW 3/7/91

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

TEST RESULTS

Plant: **R.R.A.D. Texarkana**
Sampling location: **Afterburner Inlet**

Test date(s): **2/27/91** **2/27/91** **2/28/91**

			Run Numbers			
			AIPM-4	AIPM-5	AIPM-6	AVERAGE
Ø	Net time of test (min)	-------	60.0	60.0	60.0	
NP	Net sampling points	-------	6	6	6	
Y	Meter calibration factor	-------	0.980	0.980	0.980	
Dn	Sampling nozzle diameter (in)	-------	0.194	0.194	0.194	
Cp	Pitot tube coefficient	-------	0.84	0.84	0.84	
ΔH	Average orifice pressure drop (in. H2O)	-------	0.99	0.94	1.07	**1.00**
Vm	Volume of dry gas sampled at meter conditions (cu. ft.)	-------	33.110	32.905	34.812	**33.609**
Tm	Average gas meter temperature (°F)	-------	78.0	79.8	74.8	**77.5**
Vmstd	Volume of dry gas sampled at standard conditions (scf)	-------	31.975	31.665	33.582	**32.408**
Vlc	Total H2O collected in impingers and silica gel (ml)	-------	16.1	114.8	10.9	**47.3**
Vwstd	Volume of water vapor at standard conditions (scf)	-------	0.758	5.404	0.513	**2.225**
Bws	Percent moisture by volume, as measured	-------	2.32	14.58	1.50	**6.13**
	Percent moisture by volume, at saturation	-------	65.38	100.00	39.74	**68.37**
	Percent moisture by volume, used in calculations	-------	2.32	14.58	1.50	**6.13**
Fmd	Mole fraction of dry gas	-------	0.977	0.854	0.985	**0.939**
%CO2	Percent CO2 by volume (dry)	-------	0.0	0.0	0.0	**0.0**
%O2	Percent O2 by volume (dry)	-------	21.0	21.0	21.0	**21.0**
%CO	Percent CO by volume (dry)	-------	0.0	0.0	0.0	**0.0**
%N2	Percent N2 by volume (dry)	-------	79.0	79.0	79.0	**79.0**
Md	Molecular weight - dry stack gas	-------	28.84	28.84	28.84	**28.84**
Ms	Molecular weight - stack gas	-------	28.59	27.26	28.68	**28.18**
Pbar	Barometric pressure (in. Hg)	-------	29.97	29.97	29.75	**29.90**
Pst	Static pressure of stack gas (in. H2O)	-------	-4.100	-4.100	-5.300	**-4.500**
Ps	Stack pressure - absolute (in. Hg)	-------	29.67	29.67	29.36	**29.57**
Ts	Average stack gas temperature (°F)	-------	191.0	228.8	168.2	**196.0**

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

TEST RESULTS

Plant: **R.R.A.D. Texarkana** Test date(s): 2/27/91 2/27/91 2/28/91
Sampling location: **Afterburner Inlet**

			Run Numbers			
			AIPM-4	AIPM-5	AIPM-6	AVERAGE
Vh	Average square root of velocity head (in. H2O)	....	0.9695	0.9695	1.0000	**0.9797**
Vs	Average stack gas velocity (feet/sec.)	....	61.00	64.25	62.03	**62.43**
As	Stack area (sq. in.)	....	19.6	19.6	19.6	**19.6**
Qs	Actual stack flow rate (acfm)	....	499	526	507	**511**
Qsstd	Stack flow rate - dry (scfm)	....	392	341	412	**382**
ISO	Percent isokinetic	....	90.3	102.7	90.2	**94.4**

				AIPM-4	AIPM-5	AIPM-6	AVERAGE
		Mass of pollutant	=	55.5	103.2	112.9	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**Particulate**	**mass**	**mg**	**55.5**	**103.2**	**112.9**	
Cs	**Particulate**	**concentration**	**gr/dscf**	**2.678E-02**	**5.029E-02**	**5.187E-02**	**4.298E-02**
Pmr	**Particulate**	**emission rate**	**lb/h**	**9.000E-02**	**1.471E-01**	**1.833E-01**	**1.401E-01**
		Mass of pollutant	=	9.6	40.0	61.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**Cadmium**	**mass**	**µg**	**9.6**	**40.0**	**61.0**	
Cs	**Cadmium**	**concentration**	**µg/m3**	**10.603**	**44.610**	**64.147**	**39.786**
Pmr	**Cadmium**	**emission rate**	**lb/h**	**1.557E-05**	**5.702E-05**	**9.904E-05**	**5.721E-05**
		Mass of pollutant	=	27.4	120.4	65.4	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**Chromium**	**mass**	**µg**	**27.4**	**120.4**	**65.4**	
Cs	**Chromium**	**concentration**	**µg/m3**	**30.262**	**134.276**	**68.774**	**77.770**
Pmr	**Chromium**	**emission rate**	**lb/h**	**4.443E-05**	**1.716E-04**	**1.062E-04**	**1.074E-04**

BJK ✓
4/10/91

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

TEST RESULTS

Plant: R.R.A.D. Texarkana
Sampling location: Afterburner Inlet

Test date(s): 2/27/91 2/27/91 2/28/91

				Run Numbers			
				AIPM-4	AIPM-5	AIPM-6	AVERAGE
		Mass of pollutant	=	20.0	602.0	212.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	Zinc	mass	µg	20.0	602.0	212.0	
Cs	Zinc	concentration	µg/m3	22.089	671.378	222.836	305.467
Pmr	Zinc	emission rate	lb/h	3.243E-05	8.582E-04	3.442E-04	4.116E-04
		Mass of pollutant	=	64.0	160.0	190.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	Lead	mass	µg	64.0	160.0	190.0	
Cs	Lead	concentration	µg/m3	70.684	178.439	199.801	149.641
Pmr	Lead	emission rate	lb/h	1.038E-04	2.281E-04	3.085E-04	2.135E-04
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	<pollutant>	mass	mg	0.0	0.0	0.0	
Cs	<pollutant>	concentration	gr/dscf	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pmr	<pollutant>	emission rate	lb/h	0.000E+00	0.000E+00	0.000E+00	0.000E+00
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	<pollutant>	mass	mg	0.0	0.0	0.0	
Cs	<pollutant>	concentration	gr/dscf	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pmr	<pollutant>	emission rate	lb/h	0.000E+00	0.000E+00	0.000E+00	0.000E+00
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	<pollutant>	mass	mg	0.0	0.0	0.0	
Cs	<pollutant>	concentration	gr/dscf	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pmr	<pollutant>	emission rate	lb/h	0.000E+00	0.000E+00	0.000E+00	0.000E+00

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

FIELD DATA

Plant: R.R.A.D. Texarkana
Sampling location: Afterburner Inlet
Test time (start-stop): 0945-1045

Date: 2/28/91
Run number: AIPM-7

Sample type: Part./Metals
Bar. press. (in. Hg): 29.75
Static press. (in. H20): -5.300
Filter number(s): 9010533
Stack inside dia. (in.): 5.00
Pitot tube coeff.: 0.84
Total H2O collected (ml): 7.3
% O2 by volume (dry): 21.0

Volume correction (cu. ft.): 0.000
Meter calibration factor: 0.980
Data interval (min.): 10.0
Nozzle dia. (in.): 0.194
Meter box number: FT-11
Number of traverse points: 6
% CO2 by volume (dry): 0.0
% CO by volume (dry): 0.0

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	outlet
0.0	0.129					
10.0	5.630	1.000	0.95	250	78	77
20.0	11.370	1.000	1.01	210	78	76
30.0	17.700	1.000	1.03	200	79	77
40.0	23.300	1.000	1.03	190	81	77
50.0	28.940	1.000	1.08	169	83	78
60.0	34.900	1.000	1.08	168	84	78
60.0	**34.771**	**1.000**	**1.03**	**198**	**81**	**77**

MLC 3/7/91

Validated 3-7-91

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

FIELD DATA

Plant: R.R.A.D. Texarkana
Sampling location: Afterburner Inlet
Test time (start-stop): 1153-1253

Date: 2/28/91
Run number: AIPM-8

Sample type: Part./Metals
Bar. press. (in. Hg): 29.75
Static press. (in. H2O): -5.300
Filter number(s): 9010532
Stack inside dia. (in.): 5.00
Pitot tube coeff.: 0.84
Total H2O collected (ml): 10.2
% O2 by volume (dry): 21.0

Volume correction (cu. ft.): 0.000
Meter calibration factor: 0.980
Data interval (min.): 10.0
Nozzle dia. (in.): 0.194
Meter box number: FT-11
Number of traverse points: 6
% CO2 by volume (dry): 0.0
% CO by volume (dry): 0.0

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	outlet
0.0	46.023					
10.0	52.900	1.000	1.27	74	80	78
20.0	58.450	1.000	0.96	249	81	78
30.0	64.100	1.000	0.95	253	83	78
40.0	70.250	1.000	0.95	257	85	79
50.0	75.310	1.000	0.95	260	87	80
60.0	80.973	1.000	0.95	260	87	81
60.0	**34.950**	**1.000**	**1.01**	**226**	**84**	**79**

HW 3/6/91

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

TEST RESULTS

Plant: **R.R.A.D. Texarkana**
Sampling location: **Afterburner Inlet**

Test date(s): **2/28/91** **2/28/91** **1/1/04**

			Run Numbers			
			AIPM-7	AIPM-8	0	AVERAGE
Ø	Net time of test (min)	-------	60.0	60.0	0.0	
NP	Net sampling points	-------	6	6	6	
Y	Meter calibration factor	-------	0.980	0.980	0.000	
Dn	Sampling nozzle diameter (in)	-------	0.194	0.194	0.000	
Cp	Pitot tube coefficient	-------	0.84	0.84	0.00	
ΔH	Average orifice pressure drop (in. H2O)	-------	1.03	1.01	#DIV/0!	#DIV/0!
Vm	Volume of dry gas sampled at meter conditions (cu. ft.)	-------	34.771	34.950	0.000	23.240
Tm	Average gas meter temperature (°F)	-------	78.8	81.4	#DIV/0!	#DIV/0!
Vmstd	Volume of dry gas sampled at standard conditions (scf)	-------	33.285	33.295	#DIV/0!	#DIV/0!
Vlc	Total H2O collected in impingers and silica gel (ml)	-------	7.3	10.2	0.0	5.8
Vwstd	Volume of water vapor at standard conditions (scf)	-------	0.344	0.480	0.000	0.275
Bws	Percent moisture by volume, as measured	-------	1.02	1.42	#DIV/0!	#DIV/0!
	Percent moisture by volume, at saturation	-------	76.33	100.00	#DIV/0!	#DIV/0!
	Percent moisture by volume, used in calculations	-------	1.02	1.42	#DIV/0!	#DIV/0!
Fmd	Mole fraction of dry gas	-------	0.990	0.986	#DIV/0!	#DIV/0!
%CO2	Percent CO2 by volume (dry)	-------	0.0	0.0	0.0	0.0
%O2	Percent O2 by volume (dry)	-------	21.0	21.0	0.0	14.0
%CO	Percent CO by volume (dry)	-------	0.0	0.0	0.0	0.0
%N2	Percent N2 by volume (dry)	-------	79.0	79.0	100.0	86.0
Md	Molecular weight - dry stack gas	-------	28.84	28.84	28.00	28.56
Ms	Molecular weight - stack gas	-------	28.73	28.69	#DIV/0!	#DIV/0!
Pbar	Barometric pressure (in. Hg)	-------	29.75	29.75	0.00	19.83
Pst	Static pressure of stack gas (in. H2O)	-------	-5.300	-5.300	0.000	-3.533
Ps	Stack pressure - absolute (in. Hg)	-------	29.36	29.36	0.00	19.57
Ts	Average stack gas temperature (°F)	-------	197.8	225.5	#DIV/0!	#DIV/0!

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

TEST RESULTS

Plant: **R.R.A.D. Texarkana** Test date(s): 2/28/91 2/28/91 1/1/04
Sampling location: **Afterburner Inlet**

			Run Numbers AIPM-7	AIPM-8	0	AVERAGE
Vh	Average square root of velocity head (in. H2O)	....	1.0000	1.0000	0.0000	**0.6667**
Vs	Average stack gas velocity (feet/sec.)	....	63.42	64.79	#DIV/0!	**#DIV/0!**
As	Stack area (sq. in.)	....	19.6	19.6	19.6	**19.6**
Qs	Actual stack flow rate (acfm)	....	519	530	#DIV/0!	**#DIV/0!**
Qsstd	Stack flow rate - dry (scfm)	....	404	395	#DIV/0!	**#DIV/0!**
ISO	Percent isokinetic	....	91.1	93.3	#DIV/0!	**#DIV/0!**

				AIPM-7	AIPM-8	0	AVERAGE
		Mass of pollutant	=	56.0	36.4		
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**Particulate**	**mass**	**mg**	**56.0**	**36.4**	**0.0**	
Cs	**Particulate**	**concentration**	**gr/dscf**	**2.596E-02**	**1.687E-02**	**#DIV/0!**	**#DIV/0!**
Pmr	**Particulate**	**emission rate**	**lb/h**	**9.000E-02**	**5.710E-02**	**#DIV/0!**	**#DIV/0!**
		Mass of pollutant	=	160.0	44.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**Cadmium**	**mass**	**µg**	**160.0**	**44.0**	**0.0**	
Cs	**Cadmium**	**concentration**	**µg/m3**	**169.756**	**46.669**	**#DIV/0!**	**#DIV/0!**
Pmr	**Cadmium**	**emission rate**	**lb/h**	**2.571E-04**	**6.902E-05**	**#DIV/0!**	**#DIV/0!**
		Mass of pollutant	=	75.4	9.4	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**Chromium**	**mass**	**µg**	**75.4**	**9.4**	**0.0**	
Cs	**Chromium**	**concentration**	**µg/m3**	**79.997**	**9.970**	**#DIV/0!**	**#DIV/0!**
Pmr	**Chromium**	**emission rate**	**lb/h**	**1.212E-04**	**1.475E-05**	**#DIV/0!**	**#DIV/0!**

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4/1/91

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

TEST RESULTS

Plant: R.R.A.D. Texarkana
Sampling location: Afterburner Inlet

Test date(s): 2/28/91 2/28/91 1/1/04

				Run Numbers			
				AIPM-7	AIPM-8	0	AVERAGE
		Mass of pollutant	=	612.0	82.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	Zinc	mass	µg	612.0	82.0	0.0	
Cs	Zinc	concentration	µg/m3	649.315	86.975	#DIV/0!	#DIV/0!
Pmr	Zinc	emission rate	lb/h	9.830E-04	1.286E-04	#DIV/0!	#DIV/0!
		Mass of pollutant	=	290.0	110.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	Lead	mass	µg	290.0	110.0	0.0	
Cs	Lead	concentration	µg/m3	307.682	116.673	#DIV/0!	#DIV/0!
Pmr	Lead	emission rate	lb/h	4.661E-04	1.726E-04	#DIV/0!	#DIV/0!
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	<pollutant>	mass	mg	0.0	0.0	0.0	
Cs	<pollutant>	concentration	gr/dscf	0.000E+00	0.000E+00	#DIV/0!	#DIV/0!
Pmr	<pollutant>	emission rate	lb/h	0.000E+00	0.000E+00	#DIV/0!	#DIV/0!
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	<pollutant>	mass	mg	0.0	0.0	0.0	
Cs	<pollutant>	concentration	gr/dscf	0.000E+00	0.000E+00	#DIV/0!	#DIV/0!
Pmr	<pollutant>	emission rate	lb/h	0.000E+00	0.000E+00	#DIV/0!	#DIV/0!
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	<pollutant>	mass	mg	0.0	0.0	0.0	
Cs	<pollutant>	concentration	gr/dscf	0.000E+00	0.000E+00	#DIV/0!	#DIV/0!
Pmr	<pollutant>	emission rate	lb/h	0.000E+00	0.000E+00	#DIV/0!	#DIV/0!

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3-7-91

FIELD DATA

Plant: R.R.A.D. Texarkana
Sampling location: Venturi Inlet
Test time (start-stop): 0923-1123

Date: 2/26/91
Run number: SIPM-1

Sample type: Part./Metals
Bar. press. (in. Hg): 30.06
Static press. (in. H20): -6.900
Filter number(s): 9070054
Stack inside dia. (in.): 6.00
Pitot tube coeff.: 0.84
Total H2O collected (ml): 386.1
% O2 by volume (dry): 20.0

Volume correction (cu. ft.): 0.000
Meter calibration factor: 0.974
Data interval (min.): 20.0
Nozzle dia. (in.): 0.171
Meter box number: FT-4
Number of traverse points: 6
% CO2 by volume (dry): 1.0
% CO by volume (dry): 0.0

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	outlet
0.0	726.931					
20.0	740.520	1.900	1.64	80	66	68
40.0	752.600	1.500	1.29	84	68	68
60.0	766.620	1.900	1.61	100	73	72
80.0	780.550	2.300	1.83	138	78	74
100.0	797.900	3.500	2.79	139	80	76
120.0	815.669	3.400	2.72	138	82	77
120.0	**88.738**	**2.417**	**1.98**	**113**	**75**	**73**

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

FIELD DATA

Plant: **R.R.A.D. Texarkana**
Sampling location: **Venturi Inlet**
Test time (start-stop): **1427-1527**

Date: **2/26/91**
Run number: **SIPM-2**

Sample type: **Part./Metals**
Bar. press. (in. Hg): **30.06**
Static press. (in. H20): **-5.900**
Filter number(s): **9070063**
Stack inside dia. (in.): **6.00**
Pitot tube coeff.: **0.84**
Total H2O collected (ml): **196.0**
% O2 by volume (dry): **20.0**

Volume correction (cu. ft.): **0.000**
Meter calibration factor: **0.974**
Data interval (min.): **10.0**
Nozzle dia. (in.): **0.171**
Meter box number: **FT-4**
Number of traverse points: **6**
% CO2 by volume (dry): **1.0**
% CO by volume (dry): **0.0**

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	Dry gas meter temp. (°F) outlet
0.0	815.985					
10.0	823.840	2.900	2.16	98	77	75
20.0	831.460	2.700	1.99	106	78	75
30.0	838.370	2.100	1.58	97	80	76
40.0	846.750	3.700	2.63	129	81	77
50.0	856.500	4.900	3.46	133	83	78
60.0	866.432	4.800	3.40	134	85	79
60.0	**50.447**	**3.517**	**2.54**	**116**	**81**	**77**

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

FIELD DATA

Plant: R.R.A.D. Texarkana
Sampling location: Venturi Inlet
Test time (start-stop): 0807-0907

Date: 2/27/91
Run number: SIPM-3

Sample type. Part./Metals
Bar. press. (in. Hg): 29.97
Static press. (in. H20): -5.900
Filter number(s): 9070085
Stack inside dia. (in.): 6.00
Pitot tube coeff.: 0.84
Total H2O collected (ml): 163.9
% O2 by volume (dry): 20.0

Volume correction (cu. ft.): 0.000
Meter calibration factor: 0.974
Data interval (min.): 10.0
Nozzle dia. (in.): 0.171
Meter box number: FT-4
Number of traverse points: 6
% CO2 by volume (dry): 1.0
% CO by volume (dry): 0.0

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	Dry gas meter temp. (°F) outlet
0.0	866.588					
10.0	873.850	2.200	1.65	99	75	73
20.0	882.150	3.000	2.33	80	76	72
30.0	889.500	2.500	1.86	105	78	72
40.0	897.620	3.400	2.43	128	79	72
50.0	907.200	4.500	3.22	128	80	74
60.0	916.809	4.500	3.22	128	82	75
60.0	50.221	3.350	2.45	111	78	73

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

TEST RESULTS

Plant: **R.R.A.D. Texarkana**
Sampling location: **Venturi Inlet**

Test date(s): 2/26/91 2/26/91 2/27/91

		Run Numbers			
		SIPM-1	SIPM-2	SIPM-3	AVERAGE
Θ	Net time of test (min)	120.0	60.0	60.0	
NP	Net sampling points	6	6	6	
Y	Meter calibration factor	0.974	0.974	0.974	
Dn	Sampling nozzle diameter (in)	0.171	0.171	0.171	
Cp	Pitot tube coefficient	0.84	0.84	0.84	
ΔH	Average orifice pressure drop (in. H2O)	1.98	2.54	2.45	2.32
Vm	Volume of dry gas sampled at meter conditions (cu. ft.)	88.738	50.447	50.221	63.135
Tm	Average gas meter temperature (°F)	73.5	78.7	75.7	75.9
Vmstd	Volume of dry gas sampled at standard conditions (scf)	86.356	48.688	48.586	61.210
Vlc	Total H2O collected in impingers and silica gel (ml)	385 1	196.0	163.9	248.3
Vwstd	Volume of water vapor at standard conditions (scf)	18.127	9.226	7.715	11.689
Bws	Percent moisture by volume, as measured	17.35	15.93	13.70	15.66
	Percent moisture by volume, at saturation	9.59	10.44	9.12	9.72
	Percent moisture by volume, used in calculations	9.59	10.44	9.12	9.72
Fmd	Mole fraction of dry gas	0.904	0.896	0.909	0.903
%CO2	Percent CO2 by volume (dry)	1.0	1.0	1.0	1.0
%O2	Percent O2 by volume (dry)	20.0	20.0	20.0	20.0
%CO	Percent CO by volume (dry)	0.0	0.0	0.0	0.0
%N2	Percent N2 by volume (dry)	79.0	79.0	79.0	79.0
Md	Molecular weight - dry stack gas	28.96	28.96	28.96	28.96
Ms	Molecular weight - stack gas	27.91	27.82	27.96	27.90
Pbar	Barometric pressure (in. Hg)	30.06	30.06	29.97	30.03
Psi	Static pressure of stack gas (in. H2O)	-5.900	-5.900	-5.900	-5.900
Ps	Stack pressure - absolute (in. Hg)	29.63	29.63	29.54	29.60
Ts	Average stack gas temperature (°F)	113.2	116.2	111.3	113.6

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

TEST RESULTS

Plant: **R.R.A.D. Texarkana**
Sampling location: **Venturi Inlet**

Test date(s): 2/26/91 2/26/91 2/27/91

			Run Numbers			
			SIPM-1	**SIPM-2**	**SIPM-3**	**AVERAGE**
Vh	Average square root of velocity head (in. H2O)	....	1.5355	1.8539	1.8138	**1.7344**
Vs	Average stack gas velocity (feet/sec.)	....	91.80	111.32	108.34	**103.82**
As	Stack area (sq. in.)	....	28.3	28.3	28.3	**28.3**
Qs	Actual stack flow rate (acfm)	....	1082	1311	1276	**1223**
Qsstd	Stack flow rate - dry (scfm)	....	892	1066	1058	**1005**
ISO	Percent isokinetic	....	108.7	99.9	99.2	**102.6**

				SIPM-1	SIPM-2	SIPM-3	AVERAGE
		Mass of pollutant	=	17.8	7.5	13.2	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**Particulate**	**mass**	**mg**	**17.8**	**7.5**	**13.2**	
Cs	**Particulate**	**concentration**	**gr/dscf**	3.180E-03	**2.377E-03**	**4.192E-03**	**3.250E-03**
Pmr	**Particulate**	**emission rate**	**lb/h**	**2.432E-02**	**2.171E-02**	**3.802E-02**	**2.802E-02**
		Mass of pollutant	=	11.6	11.6	5.1	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**Cadmium**	**mass**	**µg**	11.6	**11.6**	**5.1**	
Cs	**Cadmium**	**concentration**	**µg/m3**	**4.744**	**8.414**	**3.707**	**5.621**
Pmr	**Cadmium**	**emission rate**	**lb/h**	**1.585E-05**	**3.358E-05**	**1.469E-05**	**2.137E-05**
		Mass of pollutant	=	22.4	3.0	3.0	
		If below detection limits, replace 0 with 1.		0	1	1	
Mn	**Chromium**	**mass**	**µg**	**22.4**	**<3.0**	**<3.0**	
Cs	**Chromium**	**concentration**	**µg/m3**	**9.160**	**<2.176**	**<2.181**	**4.506**
Pmr	**Chromium**	**emission rate**	**lb/h**	**3.060E-05**	**<8.685E-06**	**<8.641E-06**	**1.598E-05**

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

TEST RESULTS

Plant: R.R.A.D. Texarkana
Sampling location: Venturi Inlet

Test date(s): 2/26/91 2/26/91 2/27/91

				Run Numbers			
				SIPM-1	SIPM-2	SIPM-3	AVERAGE
		Mass of pollutant	=	5.0	5.0	5.0	
		If below detection limits, replace 0 with 1.		1	1	1	
Mn	Zinc	mass	µg	<5.0	<5.0	<5.0	
Cs	Zinc	concentration	µg/m3	<2.045	<3.627	<3.634	<3.102
Pmr	Zinc	emission rate	lb/h	<6.830E-06	<1.448E-05	<1.440E-05	<1.190E-05
		Mass of pollutant	=	39.6	12.6	9.6	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	Lead	mass	µg	39.6	12.6	9.6	
Cs	Lead	concentration	µg/m3	16.194	9.139	6.978	10.770
Pmr	Lead	emission rate	lb/h	5.410E-05	3.648E-05	2.765E-05	3.941E-05
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	<pollutant>	mass	mg	0.0	0.0	0.0	
Cs	<pollutant>	concentration	gr/dscf	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pmr	<pollutant>	emission rate	lb/h	0.000E+00	0.000E+00	0.000E+00	0.000E+00
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	<pollutant>	mass	mg	0.0	0.0	0.0	
Cs	<pollutant>	concentration	gr/dscf	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pmr	<pollutant>	emission rate	lb/h	0.000E+00	0.000E+00	0.000E+00	0.000E+00
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	<pollutant>	mass	mg	0.0	0.0	0.0	
Cs	<pollutant>	concentration	gr/dscf	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pmr	<pollutant>	emission rate	lb/h	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

FIELD DATA

Plant: R.R.A.D. Texarkana
Sampling location: Venturi Inlet
Test time (start-stop): 1037-1137

Date: 2/27/91
Run number: SIPM-4

Sample type: Part./Metals
Bar. press. (in. Hg): 29.97
Static press. (in. H2O): -5.900
Filter number(s): 9070038
Stack inside dia. (in.): 6.00
Pitot tube coeff.: 0.84
Total H2O collected (ml): 155.9
% O2 by volume (dry): 20.0

Volume correction (cu. ft.): 0.000
Meter calibration factor: 0.974
Data interval (min.): 10.0
Nozzle dia. (in.): 0.171
Meter box number: PT-4
Number of traverse points: 6
% CO2 by volume (dry): 1.0
% CO by volume (dry): 0.0

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	Dry gas meter temp. (°F) outlet
0.0	916.936					
10.0	923.550	2.000	1.50	101	79	75
20.0	931.110	2.700	2.07	91	79	74
30.0	937.750	2.000	1.45	120	80	75
40.0	946.840	3.300	2.37	128	81	76
50.0	955.000	4.200	3.01	129	81	77
60.0	964.394	4.300	3.09	129	82	78
60.0	**47.458**	**3.083**	**2.25**	**116**	**80**	**76**

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

FIELD DATA

Plant: **R.R.A.D. Texarkana**
Sampling location: **Venturi Inlet**
Test time (start-stop): **1329-1429**

Date: **2/27/91**
Run number: **SIPM-5**

Sample type: **Part./Metals**
Bar. press. (in. Hg): **29.97**
Static press. (in. H2O): **-5.900**
Filter number(s): **9010500**
Stack inside dia. (in.): **6.00**
Pitot tube coeff.: **0.84**
Total H2O collected (ml): **183.7**
% O2 by volume (dry): **20.0**

Volume correction (cu. ft.): **0.000**
Meter calibration factor: **0.974**
Data interval (min.): **10.0**
Nozzle dia. (in.): **0.171**
Meter box number: **FT-4**
Number of traverse points: **6**
% CO2 by volume (dry): **1.0**
% CO by volume (dry): **0.0**

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F)	
					inlet	outlet
0.0	964.628					
10.0	972.200	2.700	2.05	97	79	75
20.0	979.730	2.600	1.92	114	79	76
30.0	987.200	2.600	1.88	125	80	76
40.0	996.100	3.500	2.50	133	82	77
50.0	1004.600	3.900	2.79	133	32	78
60.0	1013.803	4.100	2.94	133	84	79
60.0	**49.175**	**3.233**	**2.3[illegible]**	**123**	**81**	**77**

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

TEST RESULTS

Plant: **R.R.A.D. Texarkana**
Sampling location: **Venturi Inlet**

Test date(s): 2/27/91 2/27/91 1/1/04

			Run Numbers			
			SIPM-4	SIPM-5	0	AVERAGE
Ø	Net time of test (min)	-------	60.0	60.0	0.0	
NP	Net sampling points	-------	6	6	6	
Y	Meter calibration factor	-------	0.974	0.974	0.000	
Dn	Sampling nozzle diameter (in)	-------	0.171	0.171	0.000	
Cp	Pitot tube coefficient	-------	0.84	0.84	0.84	
ΔH	Average orifice pressure drop (in. H2O)	-------	2.25	2.35	#DIV/0!	#DIV/0!
Vm	Volume of dry gas sampled at meter conditions (cu. ft.)	-------	47.458	49.175	0.000	32.211
Tm	Average gas meter temperature (°F)	-------	78.1	78.9	#DIV/0!	#DIV/0!
Vmstd	Volume of dry gas sampled at standard conditions (scf)	-------	45.684	47.275	#DIV/0!	#DIV/0!
Vlc	Total H2O collected in impingers and silica gel (ml)	-------	155.9	183.7	0.0	113.2
Vwstd	Volume of water vapor at standard conditions (scf)	-------	7.338	8.647	0.000	5.328
Bws	Percent moisture by volume, as measured	-------	13.84	15.46	#DIV/0!	#DIV/0!
	Percent moisture by volume, at saturation	-------	10.52	12.48	#DIV/0!	#DIV/0!
	Percent moisture by volume, used in calculations	-------	10.52	12.48	#DIV/0!	#DIV/0!
Fmd	Mole fraction of dry gas	-------	0.895	0.875	#DIV/0!	#DIV/0!
%CO2	Percent CO2 by volume (dry)	-------	1.0	1.0	0.0	0.7
%O2	Percent O2 by volume (dry)	-------	20.0	20.0	0.0	13.3
%CO	Percent CO by volume (dry)	-------	0.0	0.0	0.0	0.0
%N2	Percent N2 by volume (dry)	-------	79.0	79.0	100.0	86.0
Md	Molecular weight - dry stack gas	-------	28.96	28.96	28.00	28.64
Ms	Molecular weight - stack gas	-------	27.81	27.59	#DIV/0!	#DIV/0!
Pbar	Barometric pressure (in. Hg)	-------	29.97	29.97	0.00	19.98
Psi	Static pressure of stack gas (in. H2O)	-------	-5.900	-5.900	0.000	-3.933
Ps	Stack pressure - absolute (in. Hg)	-------	29.54	29.54	0.00	19.69
Ts	Average stack gas temperature (°F)	-------	116.3	122.5	#DIV/0!	#DIV/0!

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

Validated 3/7/91

TEST RESULTS

Plant: **R.R.A.D. Texarkana**
Sampling location: **Venturi Inlet**

Test date(s): 2/27/91 2/27/91 1/1/04

			Run Numbers			
			SIPM-4	SIPM-5	0	AVERAGE
Vh	Average square root of velocity head (in. H2O)	....	1.7352	1.7898	0.0000	1.1750
Vs	Average stack gas velocity (feet/sec.)	....	104.38	108.66	#DIV/0!	#DIV/0!
As	Stack area (sq. in.)	....	28.3	28.3	28.3	28.3
Qs	Actual stack flow rate (acfm)	....	1230	1280	#DIV/0!	#DIV/0!
Qsstd	Stack flow rate - dry (scfm)	....	995	1002	#DIV/0!	#DIV/0!
ISO	Percent isokinetic	....	97.8	100.2	#DIV/0!	#DIV/0!

		Mass of pollutant	=	11.6	6.7		
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	Particulate	mass	mg	11.6	6.7	0.0	
Cs	Particulate	concentration	gr/dscf	3.918E-03	2.187E-03	#DIV/0!	#DIV/0!
Pmr	Particulate	emission rate	lb/h	3.342E-02	1.879E-02	#DIV/0!	#DIV/0!
		Mass of pollutant	=	4.2	5.9	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	Cadmium	mass	μg	4.2	5.9	0.0	
Cs	Cadmium	concentration	μg/m3	3.247	4.407	#DIV/0!	#DIV/0!
Pmr	Cadmium	emission rate	lb/h	1.210E-05	1.655E-05	#DIV/0!	#DIV/0!
		Mass of pollutant	=	3.0	19.4	0.0	
		If below detection limits, replace 0 with 1.		1	0	0	
Mn	Chromium	mass	μg	<3.0	19.4	0.0	
Cs	Chromium	concentration	μg/m3	<2.319	14.492	#DIV/0!	#DIV/0!
Pmr	Chromium	emission rate	lb/h	<8.643E-06	5.441E-05	#DIV/0!	#DIV/0!

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

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TEST RESULTS

Plant: **R.R.A.D. Texarkana** Test date(s): 2/27/91 2/27/91 1/1/04
Sampling location: **Venturi Inlet**

				Run Numbers SIPM-4	SIPM-5	0	AVERAGE
		Mass of pollutant	=	5.0	62.0	0.0	
		If below detection limits, replace 0 with 1.		1	0	0	
Mn	**Zinc**	**mass**	µg	**<5.0**	**62.0**	**0.0**	
Cs	**Zinc**	**concentration**	µg/m3	**<3.865**	**46.314**	**#DIV/0!**	**#DIV/0!**
Pmr	**Zinc**	**emission rate**	lb/h	**<1.441E-05**	**1.739E-04**	**#DIV/0!**	**#DIV/0!**
		Mass of pollutant	=	2.0	12.6	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**Lead**	**mass**	µg	**2.0**	**12.6**	**0.0**	
Cs	**Lead**	**concentration**	µg/m3	**1.546**	**9.412**	**#DIV/0!**	**#DIV/0!**
Pmr	**Lead**	**emission rate**	lb/h	**5.762E-06**	**3.534E-05**	**#DIV/0!**	**#DIV/0!**
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**<pollutant>**	**mass**	mg	**0.0**	**0.0**	**0.0**	
Cs	**<pollutant>**	**concentration**	gr/dscf	**0.000E+00**	**0.000E+00**	**#DIV/0!**	**#DIV/0!**
Pmr	**<pollutant>**	**emission rate**	lb/h	**0.000E+00**	**0.000E+00**	**#DIV/0!**	**#DIV/0!**
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**<pollutant>**	**mass**	mg	**0.0**	**0.0**	**0.0**	
Cs	**<pollutant>**	**concentration**	gr/dscf	**0.000E+00**	**0.000E+00**	**#DIV/0!**	**#DIV/0!**
Pmr	**<pollutant>**	**emission rate**	lb/h	**0.000E+00**	**0.000E+00**	**#DIV/0!**	**#DIV/0!**
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**<pollutant>**	**mass**	mg	**0.0**	**0.0**	**0.0**	
Cs	**<pollutant>**	**concentration**	gr/dscf	**0.000E+00**	**0.000E+00**	**#DIV/0!**	**#DIV/0!**
Pmr	**<pollutant>**	**emission rate**	lb/h	**0.000E+00**	**0.000E+00**	**#DIV/0!**	**#DIV/0!**

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

FIELD DATA

Plant: **R.R.A.D.-Texarkana**
Sampling location: **Venturi Outlet**
Test time (start-stop): **0922-1142**

Date: **2/26/91**
Run number: **SOPM-1**

Sample type: **Part./Metals**
Bar. press. (in. Hg): **30.06**
Static press. (in. H2O): **0.050**
Filter number(s): **9070069, 9070053**
Stack inside dia. (in.): **9.00**
Pitot tube coeff.: **0.84**
Total H2O collected (ml): **999.0**
% O2 by volume (dry): **20.0**

Volume correction (cu. ft.): **0.081**
Meter calibration factor: **0.992**
Data interval (min.): **15.0**
Nozzle dia. (in.): **0.252**
Meter box number: **FT-2**
Number of traverse points: **7**
% CO2 by volume (dry): **1.0**
% CO by volume (dry): **0.0**

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	outlet
0.0	829.154					
15.0	837.170	0.260	0.67	123	73	73
30.0	846.596	0.350	0.89	134	78	74
45.0	855.740	0.340	0.87	134	78	77
60.0	864.735	0.310	0.80	131	84	77
75.0	874.390	0.320	0.82	132	82	80
90.0	883.010	0.330	0.86	131	87	80
105.0	892.157	0.340	0.88	131	90	80
105.0	63.003	0.321	0.83	131	82	77

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

FIELD DATA

Plant: **R.R.A.D.-Texarkana**
Sampling location: **Venturi Outlet**
Test time (start-stop): **1430-1535**

Date: **2/26/91**
Run number: **SOPM-2**

Sample type: **Part./Metals**
Bar. press. (in. Hg): **30.06**
Static press. (in. H2O): **0.050**
Filter number(s): **9070066**
Stack inside dia. (in.): **9.00**
Pitot tube coeff.: **0.84**
Total H2O collected (ml): **74.8**
% O2 by volume (dry): **20.0**

Volume correction (cu. ft.): **0.000**
Meter calibration factor: **0.992**
Data interval (min.): **7.5**
Nozzle dia. (in.): **0.252**
Meter box number: **PT-2**
Number of traverse points: **8**
% CO2 by volume (dry): **1.0**
% CO by volume (dry): **0.0**

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	outlet
0.0	892.532					
7.5	895.610	0.400	0.49	121	80	80
15.0	900.300	0.460	0.57	119	82	79
22.5	903.650	0.440	0.53	132	85	80
30.0	907.028	0.310	0.38	133	88	80
37.5	909.890	0.300	0.37	126	85	80
45.0	913.640	0.340	0.42	126	85	80
52.5	917.210	0.410	0.52	127	89	82
60.0	920.633	0.380	0.47	127	92	83
60.0	**28.101**	**0.380**	**0.47**	**126**	**86**	**81**

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

FIELD DATA

Plant: R.R.A.D.-Texarkana
Sampling location: Venturi Outlet
Test time (start-stop): 0808-0914

Date: 2/27/91
Run number: SOPM-3

Sample type: Part./Metals
Bar. press. (in. Hg): 29.97
Static press. (in. H2O): 0.050
Filter number(s): 9070093
Stack inside dia. (in.): 9.00
Pitot tube coeff.: 0.84
Total H2O collected (ml): 93.5
% O2 by volume (dry): 20.0

Volume correction (cu. ft.): 0.000
Meter calibration factor: 0.992
Data interval (min.): 7.5
Nozzle dia. (in.): 0.252
Meter box number: FT-2
Number of traverse points: 8
% CO2 by volume (dry): 1.0
% CO by volume (dry): 0.0

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	Dry gas meter temp. (°F) outlet
0.0	920.771					
7.5	925.150	0.330	0.78	130	75	75
15.0	929.730	0.350	0.82	134	77	75
22.5	934.480	0.370	0.88	131	80	75
30.0	938.437	0.400	0.96	123	83	75
37.5	944.100	0.350	0.85	121	82	76
45.0	948.810	0.360	0.88	121	87	77
52.5	953.760	0.400	0.98	120	88	78
60.0	959.167	0.430	1.05	120	90	79
60.0	**38.396**	**0.374**	**0.90**	**125**	**83**	**76**

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

TEST RESULTS

Plant: **R.R.A.D.-Texarkana** Test date(s): **2/26/91** **2/26/91** **2/27/91**
Sampling location: **Venturi Outlet**

			Run Numbers		
		SOPM-1	SOPM-2	SOPM-3	AVERAGE
Ø	Net time of test (min)	105.0	60.0	60.0	
NP	Net sampling points	7	8	8	
Y	Meter calibration factor	0.992	0.992	0.992	
Dn	Sampling nozzle diameter (in)	0.252	0.252	0.252	
Cp	Pitot tube coefficient	0.84	0.84	0.84	
ΔH	Average orifice pressure drop (in. H2O)	0.83	0.47	0.90	0.73
Vm	Volume of dry gas sampled at meter conditions (cu. ft.)	62.922	28.101	38.396	43.140
Tm	Average gas meter temperature (°F)	79.5	83.1	79.5	80.7
Vmstd	Volume of dry gas sampled at standard conditions (scf)	61.498	27.258	37.422	42.059
Vlc	Total H2O collected in impingers and silica gel (ml)	999.0	74.8	93.5	389.1
Vwstd	Volume of water vapor at standard conditions (scf)	47.023	3.521	4.401	18.315
Bws	Percent moisture by volume, as measured	43.33	11.44	10.52	21.76
	Percent moisture by volume, at saturation	15.37	13.63	13.17	14.06
	Percent moisture by volume, used in calculations	15.37	11.44	10.52	12.45
Fmd	Mole fraction of dry gas	0.846	0.886	0.895	0.876
%CO2	Percent CO2 by volume (dry)	1.0	1.0	1.0	1.0
%O2	Percent O2 by volume (dry)	20.0	20.0	20.0	20.0
%CO	Percent CO by volume (dry)	0.0	0.0	0.0	0.0
%N2	Percent N2 by volume (dry)	79.0	79.0	79.0	79.0
Md	Molecular weight - dry stack gas	28.96	28.96	28.96	28.96
Ms	Molecular weight - stack gas	27.28	27.71	27.81	27.60
Pbar	Barometric pressure (in. Hg)	30.06	30.06	29.97	30.03
Psl	Static pressure of stack gas (in. H2O)	0.050	0.050	0.050	0.050
Ps	Stack pressure - absolute (in. Hg)	30.06	30.06	29.97	30.03
Ts	Average stack gas temperature (°F)	130.9	126.4	125.0	127.4

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

TEST RESULTS

Plant: R.R.A.D.-Texarkana
Sampling location: Venturi Outlet

Test date(s): 2/26/91 2/26/91 2/27/91

			Run Numbers			
			SOPM-1	SOPM-2	SOPM-3	AVERAGE
Vh	Average square root of velocity head (in. H2O)	....	0.5664	0.6148	0.6108	0.5973
Vs	Average stack gas velocity (feet/sec.)	....	34.53	37.04	36.75	36.11
As	Stack area (sq. in.)	....	63.6	63.6	63.6	63.6
Qs	Actual stack flow rate (acfm)	....	915	982	974	957
Qsstd	Stack flow rate - dry (scfm)	....	695	787	788	757
ISO	Percent isokinetic	....	160.5	73.7	101.0	111.7

				SOPM-1	SOPM-2	SOPM-3	AVERAGE
		Mass of pollutant	=	532.7	12.2	8.6	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	Particulate	mass	mg	532.7	12.2	8.6	
Cs	Particulate	concentration	gr/dscf	1.337E-01	6.906E-03	3.546E-03	4.804E-02
Pmr	Particulate	emission rate	lb/h	7.967E-01	4.657E-02	2.395E-02	2.891E-01
		Mass of pollutant	=	53.0	9.6	6.4	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	Cadmium	mass	μg	53.0	9.6	6.4	
Cs	Cadmium	concentration	μg/m3	30.435	12.438	6.040	16.304
Pmr	Cadmium	emission rate	lb/h	7.926E-05	3.665E-05	1.783E-05	4.458E-05
		Mass of pollutant	=	650.0	3.0	8.0	
		If below detection limits, replace 0 with 1.		0	1	1	
Mn	Chromium	mass	μg	650.0	<3.0	<3.0	
Cs	Chromium	concentration	μg/m3	373.257	<3.887	<2.831	126.658
Pmr	Chromium	emission rate	lb/h	9.721E-04	<1.146E-05	<8.356E-06	3.306E-04

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

TEST RESULTS

Plant: **R.R.A.D.-Texarkana** Test date(s): 2/26/91 2/26/91 2/27/91
Sampling location: **Venturi Outlet**

				Run Numbers			
				SOPM-1	SOPM-2	SOPM-3	AVERAGE
		Mass of pollutant	=	1500.0	5.0	5.0	
		If below detection limits, replace 0 with 1.		0	1	1	
Mn	**Zinc**	**mass**	µg	**1500.0**	**<5.0**	**<5.0**	
Cs	**Zinc**	**concentration**	µg/m3	**861.362**	**<6.478**	**<4.718**	**290.853**
Pmr	**Zinc**	**emission rate**	lb/h	**2.243E-03**	**<1.909E-05**	**<1.393E-05**	**7.588E-04**
		Mass of pollutant	=	1000.0	13.6	5.2	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**Lead**	**mass**	µg	**1000.0**	**13.6**	**5.2**	
Cs	**Lead**	**concentration**	µg/m3	**574.242**	**17.620**	**4.907**	**198.923**
Pmr	**Lead**	**emission rate**	lb/h	**1.496E-03**	**5.192E-05**	**1.448E-05**	**5.206E-04**
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**<pollutant>**	**mass**	mg	**0.0**	**0.0**	**0.0**	
Cs	**<pollutant>**	**concentration**	gr/dscf	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**
Pmr	**<pollutant>**	**emission rate**	lb/h	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**<pollutant>**	**mass**	mg	**0.0**	**0.0**	**0.0**	
Cs	**<pollutant>**	**concentration**	gr/dscf	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**
Pmr	**<pollutant>**	**emission rate**	lb/h	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	**<pollutant>**	**mass**	mg	**0.0**	**0.0**	**0.0**	
Cs	**<pollutant>**	**concentration**	gr/dscf	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**
Pmr	**<pollutant>**	**emission rate**	lb/h	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

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FIELD DATA

Plant: **R.R.A.D.-Texarkana**
Sampling location: **Venturi Outlet**
Test time (start-stop): **1034-1139**

Date: **2/27/91**
Run number: **SOPM-4**

Sample type: **Part./Metals**
Bar. press. (in. Hg): **29.97**
Static press. (in. H20): **0.050**
Filter number(s): **9070021**
Stack inside dia. (in.): **9.00**
Pitot tube coeff.: **0.84**
Total H2O collected (ml): **88.7**
% O2 by volume (dry): **20.0**

Volume correction (cu. ft.): **0.000**
Meter calibration factor: **0.992**
Data interval (min.): **7.5**
Nozzle dia. (in.): **0.252**
Meter box number: **FT-2**
Number of traverse points: **8**
% CO2 by volume (dry): **1.0**
% CO by volume (dry): **0.0**

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	Dry gas meter temp. (°F) outlet
0.0	959.294					
7.5	962.750	0.200	0.48	124	80	80
15.0	967.250	0.330	0.80	125	82	79
22.5	971.700	0.430	0.76	122	85	79
30.0	976.095	0.390	0.77	121	85	81
37.5	980.621	0.290	0.71	121	83	82
45.0	985.350	0.330	0.80	122	85	81
52.5	989.880	0.350	0.80	122	86	81
60.0	993.908	0.380	0.78	121	88	81
60.0	**34.614**	**0.338**	**0.74**	**122**	**84**	**81**

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

FIELD DATA

Plant: R.R.A.D.-Texarkana
Sampling location: Venturi Outlet
Test time (start-stop): 1327-1432

Date: 2/27/91
Run number: SOPM-5

Sample type: Part./Metals
Bar. press. (in. Hg): 29.97
Static press. (in. H2O): 0.050
Filter number(s): 9010493
Stack inside dia. (in.): 9.00
Pitot tube coeff.: 0.84
Total H2O collected (ml): 105.9
% O2 by volume (dry): 20.0

Volume correction (cu. ft.): 0.000
Meter calibration factor: 0.992
Data interval (min.): 7.5
Nozzle dia. (in.): 0.252
Meter box number: FT-2
Number of traverse points: 8
% CO2 by volume (dry): 1.0
% CO by volume (dry): 0.0

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	outlet
0.0	994.142					
7.5	998.700	0.330	0.79	128	81	82
15.0	1003.280	0.340	0.81	131	83	81
22.5	1008.350	0.370	0.90	128	87	81
30.0	1013.153	0.410	1.00	125	90	82
37.5	1017.660	0.320	0.78	126	87	82
45.0	1022.400	0.350	0.86	125	92	84
52.5	1027.450	0.380	0.93	126	95	85
60.0	1032.437	0.400	0.98	126	95	85
60.0	**38.295**	**0.363**	**0.88**	**127**	**89**	**83**

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

FIELD DATA

Plant: R.R.A.D.-Texarkana
Sampling location: Venturi Outlet
Test time (start-stop): 0800-0905

Date: 2/28/91
Run number: SOPM-6

Sample type: Part./Metals
Bar. press. (in. Hg): 29.75
Static press. (in. H2O): 0.050
Filter number(s): 9010503
Stack inside dia. (in.): 9.00
Pitot tube coeff.: 0.84
Total H2O collected (ml): 123.6
% O2 by volume (dry): 20.0

Volume correction (cu. ft.): 0.000
Meter calibration factor: 0.992
Data interval (min.): 7.5
Nozzle dia. (in.): 0.252
Meter box number: FT-2
Number of traverse points: 8
% CO2 by volume (dry): 1.0
% CO by volume (dry): 0.0

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	Dry gas meter temp. (°F) outlet
0.0	32.738					
7.5	37.030	0.310	0.72	131	75	75
15.0	41.520	0.340	0.79	130	77	75
22.5	46.260	0.390	0.91	128	81	76
30.0	51.171	0.410	0.96	128	85	76
37.5	55.000	0.320	0.76	127	85	78
45.0	60.600	0.360	0.85	129	88	78
52.5	65.430	0.400	0.95	130	90	79
60.0	70.570	0.420	1.00	130	92	80
60.0	37.832	0.369	0.87	129	84	77

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

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TEST RESULTS

Plant: **R.R.A.D.-Texarkana**
Sampling location: **Venturi Outlet**

Test date(s): 2/27/91 2/27/91 2/28/91

			Run Numbers			
			SOPM-4	SOPM-5	SOPM-6	AVERAGE
Ø	Net time of test (min)	-------	60.0	60.0	60.0	
NP	Net sampling points	-------	8	8	8	
Y	Meter calibration factor	-------	0.992	0.992	0.992	
Dn	Sampling nozzle diameter (in)	-------	0.252	0.252	0.252	
Cp	Pitot tube coefficient	-------	0.84	0.84	0.84	
ΔH	Average orifice pressure drop (in. H2O)	-------	0.74	0.88	0.87	0.83
Vm	Volume of dry gas sampled at meter conditions (cu. ft.)	-------	34.614	38.295	37.832	36.914
Tm	Average gas meter temperature (°F)	-------	82.4	85.8	80.6	82.9
Vmstd	Volume of dry gas sampled at standard conditions (scf)	-------	33.543	36.894	36.523	35.653
Vlc	Total H2O collected in impingers and silica gel (ml)	-------	88.7	105.9	123.6	106.1
Vwstd	Volume of water vapor at standard conditions (scf)	-------	4.175	4.985	5.818	4.993
Bws	Percent moisture by volume, as measured	-------	11.07	11.90	13.74	12.24
	Percent moisture by volume, at saturation	-------	12.22	13.86	14.83	13.64
	Percent moisture by volume, used in calculations	-------	11.07	11.90	13.74	12.24
Fmd	Mole fraction of dry gas	-------	0.889	0.881	0.863	0.878
%CO2	Percent CO2 by volume (dry)	-------	1.0	1.0	1.0	1.0
%O2	Percent O2 by volume (dry)	-------	20.0	20.0	20.0	20.0
%CO	Percent CO by volume (dry)	-------	0.0	0.0	0.0	0.0
%N2	Percent N2 by volume (dry)	-------	79.0	79.0	79.0	79.0
Md	Molecular weight - dry stack gas	-------	28.96	28.96	28.96	28.96
Ms	Molecular weight - stack gas	-------	27.75	27.66	27.45	27.62
Pbar	Barometric pressure (in. Hg)	-------	29.97	29.97	29.75	29.90
Psi	Static pressure of stack gas (in. H2O)	-------	0.050	0.050	0.050	0.050
Ps	Stack pressure - absolute (in. Hg)	-------	29.97	29.97	29.75	29.90
Ts	Average stack gas temperature (°F)	-------	122.3	126.9	129.1	126.1

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

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TEST RESULTS

Plant: **R.R.A.D.-Texarkana** Test date(s): 2/27/91 2/27/91 2/28/91
Sampling location: **Venturi Outlet**

			Run Numbers SOPM-4	SOPM-5	SOPM-6	AVERAGE
Vh	Average square root of velocity head (in. H2O)	-------	0.5779	0.6015	0.6064	**0.5953**
Vs	Average stack gas velocity (feet/sec.)	-------	34.72	36.35	36.98	**36.02**
As	Stack area (sq. in.)	-------	63.6	63.6	63.6	**63.6**
Qs	Actual stack flow rate (acfm)	-------	920	963	980	**955**
Qsstd	Stack flow rate - dry (scfm)	-------	744	765	754	**754**
ISO	Percent isokinetic	-------	95.9	102.5	103.0	**100.5**

				SOPM-4	SOPM-5	SOPM-6	AVERAGE
		Mass of pollutant	=	8.0	30.1	8.7	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	Particulate	mass	mg	8.0	30.1	8.7	
Cs	Particulate	concentration	gr/dscf	3.680E-03	1.259E-02	3.676E-03	6.648E-03
Pmr	Particulate	emission rate	lb/h	2.345E-02	8.255E-02	2.374E-02	4.325E-02
		Mass of pollutant	=	2.0	2.3	9.6	
		If below detection limits, replace 0 with 1.		1	0	0	
Mn	Cadmium	mass	µg	<2.0	2.3	9.6	
Cs	Cadmium	concentration	µg/m3	<2.106	2.202	9.282	4.530
Pmr	Cadmium	emission rate	lb/h	<5.864E-06	6.307E-06	2.620E-05	1.279E-05
		Mass of pollutant	=	3.0	3.0	3.0	
		If below detection limits, replace 0 with 1.		1	1	1	
Mn	Chromium	mass	µg	<3.0	<3.0	<3.0	
Cs	Chromium	concentration	µg/m3	<3.158	<2.872	<2.901	<2.977
Pmr	Chromium	emission rate	lb/h	<8.795E-06	<8.227E-06	<8.187E-06	<8.403E-06

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IT AIR QUALITY SERVICES
EMISSION TEST REPORT

TEST RESULTS

Plant: R.R.A.D.-Texarkana
Sampling location: Venturi Outlet

Test date(s): 2/27/91 2/27/91 2/28/91

				Run Numbers SOPM-4	SOPM-5	SOPM-6	AVERAGE
		Mass of pollutant	=	5.0	36.0	5.0	
		If below detection limits, replace 0 with 1.		1	0	1	
Mn	Zinc	mass	µg	<5.0	36.0	<5.0	
Cs	Zinc	concentration	µg/m3	<5.264	34.459	<4.835	14.853
Pmr	Zinc	emission rate	lb/h	<1.466E-05	9.873E-05	<1.364E-05	4.234E-05
		Mass of pollutant	=	3.5	10.6	16.6	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	Lead	mass	µg	3.5	10.6	16.6	
Cs	Lead	concentration	µg/m3	3.685	10.146	16.051	9.961
Pmr	Lead	emission rate	lb/h	1.026E-05	2.907E-05	4.530E-05	2.821E-05
		Mass of pollutant	=	1.0	10.0	100.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	<pollutant>	mass	mg	1.0	10.0	100.0	
Cs	<pollutant>	concentration	gr/dscf	4.600E-04	4.182E-03	4.225E-02	1.563E-02
Pmr	<pollutant>	emission rate	lb/h	2.932E-03	2.742E-02	2.729E-01	1.011E-01
		Mass of pollutant	=	10.0	1.0	100.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	<pollutant>	mass	mg	10.0	1.0	100.0	
Cs	<pollutant>	concentration	gr/dscf	4.600E-03	4.182E-04	4.225E-02	1.576E-02
Pmr	<pollutant>	emission rate	lb/h	2.932E-02	2.742E-03	2.729E-01	1.017E-01
		Mass of pollutant	=	100.0	1.0	10.0	
		If below detection limits, replace 0 with 1.		1	1	1	
Mn	<pollutant>	mass	mg	<100.0	<1.0	<10.0	
Cs	<pollutant>	concentration	gr/dscf	<4.600E-02	<4.182E-04	<4.225E-03	<1.688E-02
Pmr	<pollutant>	emission rate	lb/h	<2.932E-01	<2.742E-03	<2.729E-02	<1.077E-01

BBK 4/1/91

validated 11/1/90

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

FIELD DATA

Plant: **R.R.A.D.-Texarkana**
Sampling location: **Venturi Outlet**
Test time (start-stop): **0945-1050**

Date: **2/28/91**
Run number: **SOPM-7**

Sample type: **Part./Metals**
Bar. press. (in. Hg): **29.75**
Static press. (in. H2O): **0.050**
Filter number(s): **9010488**
Stack inside dia. (in.): **9.00**
Pitot tube coeff.: **0.84**
Total H2O collected (ml): **114.5**
% O2 by volume (dry): **20.0**

Volume correction (cu. ft.): **0.000**
Meter calibration factor: **0.992**
Data interval (min.): **7.5**
Nozzle dia. (in.): **0.252**
Meter box number: **FT-2**
Number of traverse points: **8**
% CO2 by volume (dry): **1.0**
% CO by volume (dry): **0.0**

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F)	
					inlet	outlet
0.0	70.700					
7.5	75.140	0.310	0.74	124	81	81
15.0	79.750	0.340	0.81	125	83	81
22.5	84.650	0.390	0.93	124	89	81
30.0	89.667	0.420	1.00	125	92	82
37.5	94.250	0.330	0.79	124	87	83
45.0	99.130	0.380	0.91	126	93	83
52.5	104.360	0.410	0.98	125	94	83
60.0	109.162	0.420	1.01	126	95	84
60.0	**38.462**	**0.375**	**0.90**	**125**	**89**	**82**

MW
3/7/91

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

validated 11 1/90

FIELD DATA

Plant: **R.R.A.D.-Texarkana**
Sampling location: **Venturi Outlet**
Test time (start-stop): **1128-1232**

Date: **2/28/91**
Run number: **SOPM-8**

Sample type: **Part./Metals**
Bar. press. (in. Hg): **29.75**
Static press. (in. H20): **0.050**
Filter number(s): **9010533**
Stack inside dia. (in.): **9.00**
Pitot tube coeff.: **0.84**
Total H2O collected (ml): **108.5**
% O2 by volume (dry): **20.0**

Volume correction (cu. ft.): **0.000**
Meter calibration factor: **0.992**
Data interval (min.): **7.5**
Nozzle dia. (in.): **0.252**
Meter box number: **FT-2**
Number of traverse points: **8**
% CO2 by volume (dry): **1.0**
% CO by volume (dry): **0.0**

Sample time (min)	Gas meter reading (cu. ft.)	Velocity head ΔP (in. H2O)	Orifice drop actual ΔH (in. H2O)	Stack Temp. (°F)	Dry gas meter temp. (°F) inlet	Dry gas meter temp. (°F) outlet
0.0	109.330					
7.5	113.560	0.280	0.67	126	84	84
15.0	118.000	0.320	0.76	125	86	83
22.5	122.800	0.390	0.93	125	89	83
30.0	127.885	0.420	1.01	125	91	82
37.5	132.200	0.300	0.71	126	87	82
45.0	136.830	0.350	0.84	125	91	83
52.5	141.800	0.400	0.97	123	94	83
60.0	146.823	0.420	1.01	124	96	84
60.0	**37.493**	**0.360**	**0.86**	**125**	**90**	**83**

MW 10/91

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

validated 11/1/90

TEST RESULTS

Plant: **R.R.A.D.-Texarkana**
Sampling location: **Venturi Outlet**

Test date(s): 2/28/91 2/28/91 1/1/04

			Run Numbers			
			SOPM-7	SOPM-8	0	AVERAGE
Ø	Net time of test (min)	-------	60 0	60.0	0.0	
NP	Net sampling points	-------	8	8	8	
Y	Meter calibration factor	-------	0.992	0.992	0.000	
Dn	Sampling nozzle diameter (in)	-------	0.252	0.252	0.000	
Cp	Pitot tube coefficient	-------	0.84	0.84	0.00	
ΔH	Average orifice pressure drop (in. H2O)	-------	0.90	0.86	#DIV/0!	#DIV/0!
Vm	Volume of dry gas sampled at meter conditions (cu. ft.)	-------	38.462	37.493	0.000	25.318
Tm	Average gas meter temperature (°F)	-------	85.8	86.4	#DIV/0!	#DIV/0!
Vmstd	Volume of dry gas sampled at standard conditions (scf)	-------	36.785	35.814	#DIV/0!	#DIV/0!
Vlc	Total H2O collected in impingers and silica gel (ml)	-------	114.5	108.5	0.0	74.3
Vwstd	Volume of water vapor at standard conditions (scf)	-------	5.390	5.107	0.000	3.499
Bws	Percent moisture by volume, as measured	-------	12.78	12.48	#DIV/0!	#DIV/0!
	Percent moisture by volume, at saturation	-------	13.22	13.22	#DIV/0!	#DIV/0!
	Percent moisture by volume, used in calculations	-------	12.78	12.48	#DIV/0!	#DIV/0!
Fmd	Mole fraction of dry gas	-------	0.872	0.875	#DIV/0!	#DIV/0!
%CO2	Percent CO2 by volume (dry)	-------	1.0	1.0	0.0	0.7
%O2	Percent O2 by volume (dry)	-------	20.0	20.0	0.0	13.3
%CO	Percent CO by volume (dry)	-------	0.0	0.0	0.0	0.0
%N2	Percent N2 by volume (dry)	-------	79.0	79.0	100.0	86.0
Md	Molecular weight - dry stack gas	-------	28.96	28.96	28.00	28.64
Ms	Molecular weight - stack gas	-------	27.56	27.59	#DIV/0!	#DIV/0!
Pbar	Barometric pressure (in. Hg)	-------	29.75	29.75	0.00	19.83
Psi	Static pressure of stack gas (in. H2O)	-------	0.050	0.050	0.000	0.033
Ps	Stack pressure - absolute (in. Hg)	-------	29.75	29.75	0.00	19.84
Ts	Average stack gas temperature (°F)	-------	124.9	124.9	#DIV/0!	#DIV/0!

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

validated 11/1/90

TEST RESULTS

Plant: R.R.A.D.-Texarkana
Sampling location: Venturi Outlet

Test date(s): 2/28/91 2/28/91 1/1/04

			Run Numbers SOPM-7	SOPM-8	0	AVERAGE
Vh	Average square root of velocity head (in. H2O)	-------	0.6115	0.5964	0.0000	0.4033
Vs	Average stack gas velocity (feet/sec.)	-------	37.08	36.27	#DIV/0!	#DIV/0!
As	Stack area (sq. in.)	-------	63.6	63.6	63.6	63.6
Qs	Actual stack flow rate (acfm)	-------	983	961	#DIV/0!	#DIV/0!
Qsstd	Stack flow rate - dry (scfm)	-------	770	755	#DIV/0!	#DIV/0!
ISO	Percent isokinetic	-------	101.6	100.8	#DIV/0!	#DIV/0!

		Mass of pollutant	=	6.7	9.2	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	Particulate	mass	mg	6.7	9.2	0.0	
Cs	Particulate	concentration	gr/dscf	2.810E-03	3.964E-03	#DIV/0!	#DIV/0!
Pmr	Particulate	emission rate	lb/h	1.854E-02	2.566E-02	#DIV/0!	#DIV/0!
		Mass of pollutant	=	2.0	12.6	0.0	
		If below detection limits, replace 0 with 1.		1	0	0	
Mn	Cadmium	mass	µg	<2.0	12.6	0.0	
Cs	Cadmium	concentration	µg/m3	<1.920	12.424	#DIV/0!	#DIV/0!
Pmr	Cadmium	emission rate	lb/h	<5.535E-06	3.515E-05	#DIV/0!	#DIV/0!
		Mass of pollutant	=	10.4	3.0	0.0	
		If below detection limits, replace 0 with 1.		0	1	0	
Mn	Chromium	mass	µg	10.4	<3.0	0.0	
Cs	Chromium	concentration	µg/m3	9.984	<2.958	#DIV/0!	#DIV/0!
Pmr	Chromium	emission rate	lb/h	2.878E-05	<8.369E-06	#DIV/0!	#DIV/0!

4/ /91

IT AIR QUALITY SERVICES
EMISSION TEST REPORT

validated 11/1/90

TEST RESULTS

Plant: R.R.A.D.-Texarkana
Sampling location: Venturi Outlet

Test date(s): 2/28/91 2/28/91 1/1/04

				Run Numbers SOPM-7	SOPM-8	0	AVERAGE
		Mass of pollutant	=	15.0	14.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	Zinc	mass	µg	15.0	14.0	0.0	
Cs	Zinc	concentration	µg/m3	14.401	13.805	#DIV/0!	#DIV/0!
Pmr	Zinc	emission rate	lb/h	4.151E-05	3.905E-05	#DIV/0!	#DIV/0!
		Mass of pollutant	=	19.6	9.6	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	Lead	mass	µg	19.6	9.6	0.0	
Cs	Lead	concentration	µg/m3	18.817	9.466	#DIV/0!	#DIV/0!
Pmr	Lead	emission rate	lb/h	5.424E-05	2.678E-05	#DIV/0!	#DIV/0!
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	<pollutant>	mass	mg	0.0	0.0	0.0	
Cs	<pollutant>	concentration	gr/dscf	0.000E+00	0.000E+00	#DIV/0!	#DIV/0!
Pmr	<pollutant>	emission rate	lb/h	0.000E+00	0.000E+00	#DIV/0!	#DIV/0!
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	<pollutant>	mass	mg	0.0	0.0	0.0	
Cs	<pollutant>	concentration	gr/dscf	0.000E+00	0.000E+00	#DIV/0!	#DIV/0!
Pmr	<pollutant>	emission rate	lb/h	0.000E+00	0.000E+00	#DIV/0!	#DIV/0!
		Mass of pollutant	=	0.0	0.0	0.0	
		If below detection limits, replace 0 with 1.		0	0	0	
Mn	<pollutant>	mass	mg	0.0	0.0	0.0	
Cs	<pollutant>	concentration	gr/dscf	0.000E+00	0.000E+00	#DIV/0!	#DIV/0!
Pmr	<pollutant>	emission rate	lb/h	0.000E+00	0.000E+00	#DIV/0!	#DIV/0!

RJF 4/1/91

APPENDIX B

FIELD DATA SHEETS

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

Plant U.S.ATHAMA - RRAD

Date 2/25/91

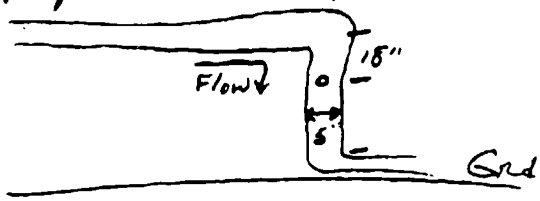
Sampling location Afterburner Inlet

Inside of far wall to outside of nipple ~~4¾"~~ 4¾"

Inside of near wall to outside of nipple (nipple length):

2¼"

Stack inside diameter, inches 2½" (effective sample cross-section) *



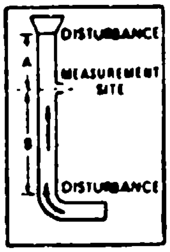
Distance downstream from flow disturbance (Distance B):

18 inches / diameter = ________ dd

Distance upstream from flow disturbance (Distance A):

50 inches / diameter = ________ dd

Calculated by B



SCHEMATIC OF SAMPLING LOCATION

* nipple extends into duct
6" I.D.
2¼" ∴ per B. Reed - Use 5" Ø

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	NIPPLE LENGTH	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
		5"		2¼"	

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

Plant USATHAMA - RRAD

Date 2/25/91

Sampling location FBPS Venturi Inlet

Inside of far wall to outside of nipple —

Inside of near wall to outside of nipple (nipple length):

—

Stack inside diameter, inches 6"

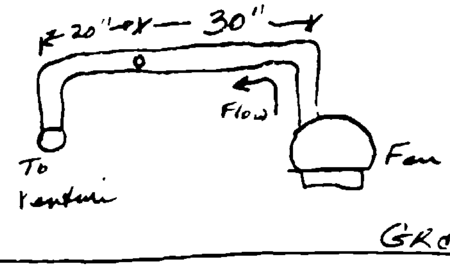
Distance downstream from flow disturbance (Distance B):

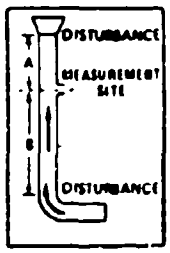
30 inches / diameter = 5 dd

Distance upstream from flow disturbance (Distance A):

20 inches / diameter = $3\bar{3}$ dd

Calculated by (B)





SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	NIPPLE LENGTH	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	.044	6"	.264	0	.264 Adj. ~~.264~~ .50
2	.146		.876		.876
3	.296		1.776		1.776
4	.704		4.224		4.224
5	.854		5.07		5.07
6	.956		5.736		ADJUSTED 5.50

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

Plant USATHAMA - RRAD

Date 2/25/91

Sampling location FBPS Venturi Outlet

Inside of far wall to outside of nipple 13"

Inside of near wall to outside of nipple (nipple length):

4"

Stack inside diameter, inches 9"

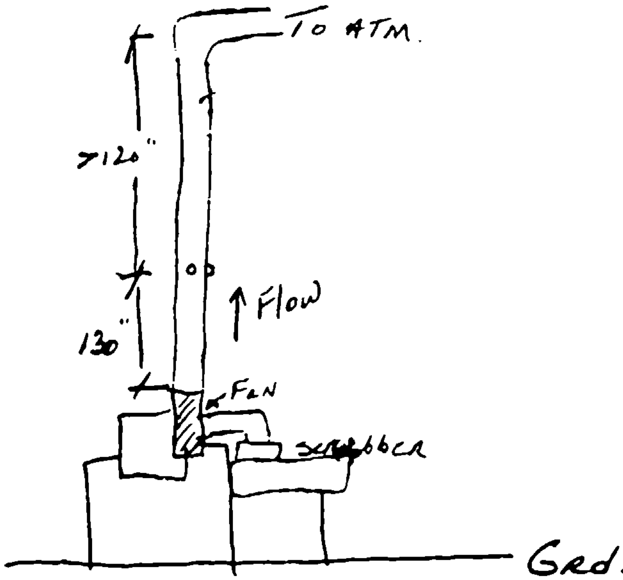
Distance downstream from flow disturbance (Distance B):

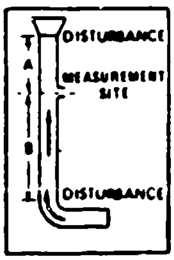
130 inches / diameter = 14.4 dd

Distance upstream from flow disturbance (Distance A):

>120 inches / diameter = 13.3 dd

Calculated by [illegible]





SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	NIPPLE LENGTH	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	.067	9"	.603	4"	4 5/8"
2	.25		2.25		6 1/4"
3	.75		6.75		10 3/4"
4	.933		8.40		12 3/8"

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City RRAD - Texarkana Date 2/26/91

Sampling Location Venturi Outlet Clock Time 0710

Run No. V-1 Operator (B)/PF

Barometric Pressure, in.Hg 30.06 Static Pressure, in.H_2O +.05

Moisture, % ≈ 11% Molecular wt., Dry ______ Pitot Tube, Cp .84

Stack Dimension, in. Diameter or Side 1 9 Side 2 ______

static +.05

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
A-1	.35	118
2	.36	118
3	.34	118
4	.32	119
B 1	.32	117
2	.36	118
3	.36	119
4	.35	120
	Ave .345	Ave = 118°F

CALCULATIONS

$M_s = M_d \times (1 - \frac{H_2O}{100}) + 18 (\frac{H_2O}{100})$

$M_s = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$M_s =$

$T_s =$ °F = °R = (°F + 460)

$P_s = P_b + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$P_s =$ in.Hg

$\sqrt{\Delta P} =$

$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s, °F}{P_s \times M_s}}$

$V_s = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{\quad \times \quad}}$

$V_s =$ ft/s

$A_s =$ ft²

$Q_s = V_s \times A_s \times \frac{60\ s}{m}$

$Q_s = \quad \times \quad \times 60$

$Q_s =$ acfm

$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times (1 - \frac{H_2O}{100})$

$Q_{s_{std}} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Q_{s_{std}} =$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City RRAD – Texarkana Date 2/26/91

Sampling Location Venturi Inlet Clock Time 0715

Run No. V-1 Operator (BB)/RF

Barometric Pressure, in.Hg ~~30.04~~ 30.06 Static Pressure, in.H_2O -5.9

est. Moisture, % ≈ 9% Molecular wt., Dry ______ Pitot Tube, Cp .84

Stack Dimension, in. Diameter or Side 1 6" Side 2 ______

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
A 1	3.0	85
2	2.6	106
3	2.2	120
4	2.4	122
5	3.0	123
6	3.3	123
7		
	Ave 2.75	Ave 113°F
AB – Inlet		
½	.95	
	.98	
static	-4.1	

CALCULATIONS

$M_s = M_d \times (1 - \frac{H_2O}{100}) + 18 (\frac{H_2O_s}{100})$

$M_s = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$M_s =$

$T_s =$ °F + °R = (°F + 460)

$P_s = P_b + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$P_s =$ in.Hg

$\sqrt{\Delta P} =$

$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s, °F}{P_s \times M_s}}$

$V_s = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{\quad \times \quad}}$

$V_s =$ ft/s

$A_s =$ ft²

$Q_s = V_s \times A_s \times \frac{60\ s}{m}$

$Q_s = \quad \times \quad \times 60$

$Q_s =$ acfm

$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times (1 - \frac{H_2O\ \%}{100})$

$Q_{s_{std}} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Q_{s_{std}} =$ dscfm

FIELD AUDIT REPORT: DRY GAS METER
BY CRITICAL ORIFICE

DATE: 2/25/91 CLIENT: USATHAMA

BAROMETRIC PRESSURE (P_{bar}): 30.09 in.Hg METER BOX NO. FT-11

ORIFICE NO. 1 PRETEST Y: .980 $\Delta H@$ 1.79 in.H_2O

ORIFICE K FACTOR: 4.738×10^{-4} AUDITOR: 83

Orifice manometer reading ΔH, in.H_2O	Dry gas meter reading V_i/V_f, ft³	Temperatures					Duration of run θ min.
		Ambient		Dry gas meter			
		T_{ai}/T_{af}, °F	Average T_a, °F	Inlet T_{ii}/T_{if}, °F	Outlet T_{oi}/T_{of}, °F	Average T_m, °F	
1.73	750.3	70	70	71	68	71	16:13 91/100
@18" Hg	762.4	70		75	70		

Dry gas meter V_m, ft³	$V_{m_{std}}$, ft³	$V_{m_{act}}$, ft³	Audit, Y	Y deviation, %	Audit $\Delta H@$, in.H_2O	$\Delta H@$ Deviation, in.H_2O
12.1	12.15	12.023	.990	-1.02	1.74	-0.05

$$V_{m_{std}} = \frac{17.647(V_m)(P_{bar} + \Delta H/13.6)}{(T_m + 460)} = \quad ft^3$$

$$V_{m_{act}} = \frac{1203(\emptyset)(K)(P_{bar})}{(T_a + 460)^{1/2}} = \quad ft^3$$

$$\text{Audit } Y = \frac{V_{m_{act}}}{V_{m_{std}}} = \qquad \text{Y deviation} = \frac{\text{Audit Y} - \text{Pretest Y}}{\text{Pretest Y}} \times 100 =$$

$$\text{Audit } \Delta H@ = (0.0317)(\Delta H)(P_{bar})(T_m + 460)\left[\frac{\emptyset}{Y(V_m)(P_{bar} + \Delta H/13.6)}\right]^2 = \quad in.H_2O$$

Audit Y must be in the range, pretest Y ±0.05 Y.
Audit $\Delta H@$ must be in the range pretest $\Delta H@$ ±0.15 inches H_2O.

FIELD AUDIT REPORT: DRY GAS METER
BY CRITICAL ORIFICE

DATE: 2/25/91 CLIENT: USATHAMA

BAROMETRIC PRESSURE (P_{bar}): 30.09 in.Hg METER BOX NO. FT-4

ORIFICE NO. 7 PRETEST Y: .974 $\Delta H@$ 2.03 in.H_2O

ORIFICE K FACTOR: 5.066×10^{-4} AUDITOR: SB

Orifice manometer reading ΔH, in.H_2O	Dry gas meter reading V_i/V_f, ft³	Temperatures: Ambient T_{ai}/T_{af}, °F	Ambient Average T_a, °F	Dry gas meter Inlet T_{ii}/T_{if}, °F	Dry gas meter Outlet T_{oi}/T_{of}, °F	Dry gas meter Average T_m, °F	Duration of run Ø min.
2.03	713.4	70	70	66	68	68	15:43 35/
@ 21 Hz	726.10	70		67	71		

Dry gas meter V_m, ft³	$V_{m_{std}}$, ft³	$V_{m_{act}}$, ft³	Audit, Y	Y deviation, %	Audit $\Delta H@$, in.H_2O	$\Delta H@$ Deviation, in.H_2O
12.7	12.835	12.295	.958	1.6%	1.88	-.15 ✓

$$V_{m_{std}} = \frac{17.647(V_m)(P_{bar} + \Delta H/13.6)}{(T_m + 460)} = 12.835 \text{ ft}^3$$

$$V_{m_{act}} = \frac{1203(\overset{15.4339}{Ø})(\overset{5.066 \times 10^{-4}}{K})(\overset{30.09}{P_{bar}})}{(T_a + 460)^{1/2}} = 12.295 \text{ ft}^3$$

$$\text{Audit Y} = \frac{V_{m_{act}}}{V_{m_{std}}} = \qquad \text{Y deviation} = \frac{\overset{Pre}{\cancel{\text{Audit}}}\text{ Y} - \overset{Aud}{\cancel{\text{Pretest}}}\text{ Y}}{\text{Pretest Y}} \times 100 =$$

$$\text{Audit } \Delta H@ = (0.0317)(\Delta H)(P_{bar})(T_m + 460)\left[\frac{Ø}{Y\,(V_m)(P_{bar} + \Delta H/13.6)}\right]^2 = \quad \text{in.}H_2O$$

Audit Y must be in the range, pretest Y ±0.05 Y.
Audit $\Delta H@$ must be in the range pretest $\Delta H@$ ±0.15 inches H_2O.

FIELD AUDIT REPORT: DRY GAS METER
BY CRITICAL ORIFICE

DATE: 2/25/91 CLIENT: USATHAMA

BAROMETRIC PRESSURE (P_{bar}): 30.09 in.Hg METER BOX NO. FT-2

ORIFICE NO. 1 PRETEST Y: .992 $\Delta H@$ 1.41 in.H_2O

ORIFICE K FACTOR: 4.738×10^{-4} AUDITOR: 83

Orifice manometer reading ΔH, in.H_2O	Dry gas meter reading V_i/V_f, ft³	Temperatures: Ambient T_{ai}/T_{af}, °F	Ambient Average T_a, °F	Dry gas meter Inlet T_{ii}/T_{if}, °F	Dry gas meter Outlet T_{oi}/T_{of}, °F	Dry gas meter Average T_m, °F	Duration of run Ø min.
1.3	817.10	70	70	78	68	73.5	15.04 17/60
@ 20" Hg	828.6	70		78	70		15:0428

Dry gas meter V_m, ft³	$V_{m_{std}}$, ft³	$V_{m_{act}}$, ft³	Audit, Y	Y deviation, %	Audit $\Delta H@$, in.H_2O	$\Delta H@$ Deviation, in.H_2O
11.5	11.482	11.210	.976	1.6% ✓	1.32	-0.09 ✓

11.5 30.09 1.3

$$V_{m_{std}} = \frac{17.647(V_m)(P_{bar} + \Delta H/13.6)}{(T_m + 460)} = \quad ft^3$$

73.5

15.0428 4.738×10^{-4} 30.09

$$V_{m_{act}} = \frac{1203(\emptyset)(K)(P_{bar})}{(T_a + 460)^{1/2}} = \quad ft^3$$

70

$$\text{Audit } Y = \frac{V_{m_{act}}}{V_{m_{std}}} = .976 \qquad Y \text{ deviation} = \frac{\text{Pre } \cancel{\text{Audit}}\ Y - \text{Audit } \cancel{\text{Pretest}}\ Y}{\text{Pretest } Y} \times 100 =$$

$$\text{Audit } \Delta H@ = (0.0317)(\Delta H)(P_{bar})(T_m + 460)\left[\frac{\emptyset}{Y\,(V_m)(P_{bar} + \Delta H/13.6)}\right]^2 = \quad in.H_2O$$

Audit Y must be in the range, pretest Y ±0.05 Y.
Audit $\Delta H@$ must be in the range pretest $\Delta H@$ ±0.15 inches H_2O.

THERMOCOUPLE DIGITAL INDICATOR
AUDIT DATA SHEET

Date 2/25/91 Indicator No. FT-2 (STK. only) Operator [illegible]

Test Point No.	Millivolt signal*	Equivalent temperature, °F*	Digital indicator temperature reading, °F	Difference, %
1		0	2	-.43
2		100	102	-.36
3		200	201	-.15
4		300	301	-.13

Percent difference must be less than or equal to 0.5%.

Percent difference:

$$\frac{(\text{Equivalent temperature } ^\circ R - \text{Digital indicator temperature reading } ^\circ R)(100\%)}{(\text{Equivalent temperature } ^\circ R)}$$

Where °R = °F + 460°F

* These values are to be obtained from the calibration data sheet for the calibration device.

THERMOCOUPLE DIGITAL INDICATOR
AUDIT DATA SHEET

Date 2/25/91 Indicator No. FT-4 Operator 83

Test Point No.	Millivolt signal*	Equivalent temperature, °F*	Digital indicator temperature reading, °F	Difference, %
1		0	-1	.22
2		100	100	0
3		200	200	0
4		300	300	0

Percent difference must be less than or equal to 0.5%.

Percent difference:

$$\frac{(\text{Equivalent temperature } ^\circ R - \text{Digital indicator temperature reading } ^\circ R)(100\%)}{(\text{Equivalent temperature } ^\circ R)}$$

Where °R = °F + 460°F

* These values are to be obtained from the calibration data sheet for the calibration device.

THERMOCOUPLE DIGITAL INDICATOR
AUDIT DATA SHEET

Date 2/25/91 Indicator No. FT-11 Operator SB

Test Point No.	Millivolt signal*	Equivalent temperature, °F*	Digital indicator temperature reading, °F	Difference, %
1		0	-2	-.43
2		100	99	.18
3		500	500	0
4		600	601	-.09

- Percent difference must be less than or equal to 0.5%.

Percent difference:

$$\frac{(\text{Equivalent temperature } ^\circ R - \text{Digital indicator temperature reading } ^\circ R)(100\%)}{(\text{Equivalent temperature } ^\circ R)}$$

Where °R = °F + 460°F

* These values are to be obtained from the calibration data sheet for the calibration device.

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
RAAD - Texarkana	2 06191	AB INlet	Part / Metals	AIPM-1

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
CB	30.06	-4.1	70	9070076	5'		.84	4' Glass	.194	3-109

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
≈10	FT-11	1.79	.980	—	—	I-2	—	21	0.001	5	0.0	1.27	250	250	/	/

Single pt. TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL ACTUAL	STACK TEMP. (T_s), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	0924	763.179									
1	20		774.6	.95	0.98	0.98	192	70	70	1	270	64
	40		785.6	.95	.94	.94	221	74	71	1	271	64
	60		795.89	.95	.94	.94	250	80	74	2	270	66
	80		805.80	.95	.89	.89	269	83	76	2	269	64
	100		817.36	.95	0.95	0.95	229	85	77	3	271	65
	120	1124	828.631	0.95	0.94	0.94	208	85	78	3	239	64
	140											
	160											
	90											
	100		V_m = 65.452	$\bar{\Delta p}$ = .975	0.94			ave = 77°F				
	110											
	120		$V_{m_{std}}$ = 63.509									
			B_{ws} = 8.1% ✓									

91-03-046

MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant R.R.A.D. - Texarkana Sample date 2/26/91

Sample location Afterburner Inlet Recovery date 2/26/91

Run number AIPM-1 Recovered by CB/PF

Filter number(s) 9070076

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	658.9	626.5	491.4	ml (g)	Final wt	747.9		g
Initial volume (wt)	608.7	592.0	483.5	ml (g)	Initial wt	~~485.5~~ 724.7		g
Net volume (wt)	50.2	34.5	7.9	ml (g)	Net wt	23.2		g

Description of impinger water 80 % spent

yellowish Color (1st Imp. only)

Total moisture ~~215.8~~ 115.8 g (83)

RECOVERED SAMPLE

Filter container number(s) 12208-B Sealed ✓

Description of particulate on filter Light Blackish

Acetone probe rinse container no. 12208-A Liquid level marked ✓

Impinger contents (1+2) container no. 12210-A Liquid level marked ✓

HNO_3/H_2O_2 blank container no. 12211-A Liquid level marked ✓

Impinger contents (3+4) container no. — Liquid level marked

$KMnO_4$ blank container no. — Liquid level marked

Samples stored and locked

Remarks Acetone Blank. → 12209-A

Pallflex Filter Blank (#9070094) - Cont. # 11074-B

HNO_3 Blank. - 12211-A

LABORATORY CUSTODY

Received by [signature] Date 3/5/91

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
KRAD - Texarkana, Tx	2/26/91	Afterburner INlet	Part / Metals	AIPM-2

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
83	30.86	-4.1	70	92 F0232	5		.84	4' Glass	.194	3-109

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
≈9	FT-11	1.79	.980	—	—	I-2	—	11	0.006	15	0.02	1.27	250	250	—	—

Single TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1426	831.237									
	10		837.01	.94	0.97	0.97	203	77	76	10	271	68
	20		842.90	.94	0.97	0.97	203	78	77	11	277	69
	30		847.81	.94	0.94	0.94	227	80	78	14	270	68
	40		853.64	.94	0.92	0.92	240	82	78	14	264	67
	50		858.80	.94	0.93	0.93	258	84	79	15	259	62
	60	1526	864.124	.94	0.89	0.89	268	85	71	15	260	63
					.94			79.4				
			Vm 32.887									
			Vmstd = 31.792									
			Wstd 4.495									
			Bws .12%									

1-03-046

MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant RRAD Sample date 2/26/91

Sample location After burner Inlet Recovery date 2/26/91

Run number AIPM-2 Recovered by ®/PF

Filter number(s) 9070092

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	672.8	597.8	478.7	ml (g)	Final wt	781.0		g
Initial volume (wt)	609.7	591.4	476.1	ml (g)	Initial wt	757.6		g
Net volume (wt)	63.1	6.4	2.6	ml (g)	Net wt	23.4		g

Description of impinger water ______ 40 % spent

1st Imp => yellowish; Others - Clear

Total moisture 95.5 g

RECOVERED SAMPLE

Filter container number(s) 11080-B Sealed ✓

Description of particulate on filter Blackish-grey; Some large Chunks.

~~ACETONE~~ probe rinse container no. 11080-A ~~12209-A~~ Liquid level marked ✓

Impinger contents (1+2) container no. 11081-A Liquid level marked ✓

HNO_3/H_2O_2 blank container no. ✓ 12211-A ~~12211-A~~ Liquid level marked ✓

Impinger contents (3+4) container no. — Liquid level marked

$KMnO_4$ blank container no. — Liquid level marked

Samples stored and locked

Remarks Ace. Blank - 12209-A

LABORATORY CUSTODY

Received by Jim Anderson Date 3/5/91

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
R.RAD - Texarkana	2/27/91	Afterburner Inlet	Part	AIPM-3

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
B	29.97	-4.1	70	9070052	5		.84	4' Glass	.194	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
10	FF-11	1.79	.980	—	-	I-2	-	16	0.001	5	0.001	1.27	250	250	—	—

single TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	0806	865.797									
1	10		871.00	.94	0.86	0.86	275	72	71	1	250	60
	~~30~~ 20		876.08	.94	0.86	0.86	279	72	72	1	251	59
	~~40~~ 30		881.207	.94	0.86	0.86	281	74	72	1	252	61
	~~50~~ 40		886.48	.94	0.86	0.86	283	78	73	1	253	62
	~~60~~ 50		891.74	.94	0.86	0.86	285	80	74	1	257	63
	60	0906	896.902	.94	.86	.86	285	82	75	1	256	66
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X1-03-046

MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant R.R.A.D TEXARKANA Sample date 2/27/91

Sample location AFTER BURNER - INLET Recovery date 2/27/91

Run number AIAM - 3 Recovered by PF / CB

Filter number(s) [redacted] 9070052

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	595.7	107.9	478.4	ml (g)	Final wt	722.7	NA	g
Initial volume (wt)	600.0	106.2	477.6	ml (g)	Initial wt	715.0	NA	g
Net volume (wt)	-4.3	1.7	0.8	ml (g)	Net wt	7.7		g

Description of impinger water ______ 20 % spent

A little cloudy

Total moisture 5.9 g

RECOVERED SAMPLE

Filter container number(s) 11030-B Sealed ✓

Description of particulate on filter light brown

Acetone probe rinse container no. 11030-A Liquid level marked ✓

Impinger contents (1+2) container no. 11118-A Liquid level marked ✓

HNO_3/H_2O_2 blank container no. 12212-A Liquid level marked ✓

Impinger contents (3+4) container no. ______ Liquid level marked ______

$KMnO_4$ blank container no. ______ Liquid level marked ______

Samples stored and locked ✓

Remarks Ace. Blnk - 12209-A

HNO_3 - 12211-A

LABORATORY CUSTODY

Received by [signature] Date 3/5/91

Remarks ______

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
RRAD - Texarkana	2/12/91	Afterburner Inlet	Part/Metals	AIPM-4

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE C_p	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
83	29.97	-4.1	72	9070045	5		.84	4' Glass	.184	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
10	FT-11	1.79	.980	—	—	I-2	—	15	0.003	5	0.038	1.27	250	250	/	—

sample TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (T_s), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1038	897.928									
1	10		903.34	.94	1.06	1.06	146	76	76	2	260	68
.	20		908.80	.94	1.02	1.02	168	77	76	2	261	66
	30		914.40	.94	.98	.98	192	79	76	2	260	64
	40		919.80	.94	.96	.96	210	81	77	2	257	66
	50		925.50	.94	.96	.96	214	81	77	2	256	67
	60	1138	931.038	.94	.96	.96	216	82	78	2	251	66

X1-03-046

MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant KRAD - Texarkana Sample date 2-27-91

Sample location After Burner Inlet Recovery date 2-27-91

Run number AFBM-4 Recovered by DE/CB

Filter number(s) 9070045

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	604.8	594.8	502.0	ml (g)	Final wt	765.4		g
Initial volume (wt)	606.6	588.2	500.8	ml (g)	Initial wt	755.3		g
Net volume (wt)	-1.8	6.6	1.2	ml (g)	Net wt	10.1		g

Description of impinger water ____ 30 % spent

YELLOW TINT

Total moisture 16.1 g

RECOVERED SAMPLE

Filter container number(s) 11125-B Sealed ✓

Description of particulate on filter ____

Acetone probe rinse container no. 11125-A Liquid level marked ✓

Impinger contents (1+2) container no. 11126-A Liquid level marked ✓

HNO_3/H_2O_2 blank container no. 12212-A Liquid level marked ✓

Impinger contents (3+4) container no. — Liquid level marked ____

$KMnO_4$ blank container no. — Liquid level marked ____

Samples stored and locked ✓

Remarks ____

LABORATORY CUSTODY

Received by [signature] Date 3/5/91

Remarks ____

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
RRAD - Texarkana	2/27/91	After burner Inlet	~~At~~ Part./Metals	AIPM-5

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(s)	STACK INSIDE DIA. (in.)	PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
B	29.97	-4.1	72	9010412	5	.84	3' Glass	.194	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL FACTOR (Y)	THERM NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT	PITOT LEAK CHECK FINAL
10	FT-11	1.79	.980	—	—	I-2	—	13	0.014	4	0.009	1.27	250	250	—	—

Single TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL ACT	STACK TEMP. (T_s), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1330	931.815									
	10		937.44	.94	1.01	1.01	176	78	77	1	270	66
	20		942.94	.94	0.97	0.97	205	78	77	2	260	64
	30		948.40	.94	0.94	0.94	228	80	78	2	258	63
	40		953.82	.94	0.91	0.91	246	82	79	3	254	62
	50		959.40	.94	0.90	0.90	256	84	80	3	256	64
	60	1430	964.720	.94	0.90	0.70	262	85	80	3	259	66

A1-03-046

MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant RRAD TEXARKANA Sample date 2-27-91

Sample location AFTERBURNER INLET Recovery date 2/27/91

Run number AIDm-5 Recovered by BB/PF

Filter number(s) 9010412 (Glass-fiber)

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	688.8	625.5	478.7	ml (g)	Final wt	730.6		g
Initial volume (wt)	596.4	611.3	478.4	ml (g)	Initial wt	722.7		g
Net volume (wt)	92.4	14.2	0.3	ml (g)	Net wt	7.9		g

Description of impinger water 1st Imp. slightly yellow 60 % spent

Total moisture 114.8 g

RECOVERED SAMPLE

Filter container number(s) 11133-B Sealed ✓

Description of particulate on filter darkish grey

Acetone probe rinse container no. 11133-A Liquid level marked ✓

Impinger contents (1+2) container no. 11134-A Liquid level marked ✓

HNO_3/H_2O_2 blank container no. 12212-A Liquid level marked ✓

Impinger contents (3+4) container no. — Liquid level marked

$KMnO_4$ blank container no. — Liquid level marked

Samples stored and locked

Remarks Glass fiber filter Blank ⇒

LABORATORY CUSTODY

Received by Jon Anderson Date 3/5/91

Remarks

O_2 - 21%. CO_2 - 0%

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
RRAD - Texarkana	2/28/91	AB Inlet	Part/Metals	#IPM-6

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
(SB) JPF	29.75	-5.3	72	9010487	5		.84	3' Glass	.194	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
2.0	FT-11	1.79	.980	—	—	I-72	—	15	.005	5	0.0	1.26	250	250	✓	✓

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft³	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	0800	965.043									
	10		970.76	1.0	1.02	1.02	202	73	72	2	260	68
	20		976.70	1.0	1.12	1.12	141	73	72	2	260	66
	30		982.37	1.0	1.08	1.08	159	74	72	3	259	67
	40		988.42	1.0	1.07	1.07	168	77	73	4	261	66
	50		994.00	1.0	1.07	1.07	171	79	74	4	262	69
	60	0900	999.855	1.0	1.07	1.07	170	81	75	4	261	70

XI-03-046

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant R.R.A.A TEXARKANA   Sample date 2-28-91
Sample location AFTERBURNER INLET   Recovery date 2/28/91
Run number AIPM-6   Recovered by CB/PF
Filter number(s) 9010487

MOISTURE

Impingers	1	2	3	
Final volume (wt)	597.3	602.3	484.2	ml(g)
Initial volume (wt)	600.0	595.9	483.7	ml(g)
Net volume (wt)	-2.7	6.4	.5	ml(g)

Description of impinger water YELLOW TINT

Silica gel
Final wt 738.3 g
Initial wt 731.6 g
Net wt 6.7 g
40 % spent

Total moisture 10.9 g

RECOVERED SAMPLE

Filter container number(s) 11137-B   Sealed ✓
Description of particulate on filter

Ace. Probe rinse container no. 11137-A   Liquid level marked ✓
Ace. blank container no. 12209-A   Liquid level marked ✓
Impinger contents container no. 11138-A   Liquid level marked ✓
blank container no. —   Liquid level marked —
Samples stored and locked ~~Glass filter~~
Remarks HNO_3 Blank - 12211A   FILTER BLANK - 11126B
HNO_3; H_2O_2 BLANK - 12212A

LABORATORY CUSTODY

Received by [signature]   Date 3/5/91
Remarks

EMISSION TESTING FIE' D DATA

PLANT AND CITY	DATE	SAMPLING LOCATIC	SAMPLE TYPE	RUN NUMBER
RRAD-Texarkana	2/28/91	AB Inlet	Part./Metals	AIPM-7

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)	PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
83	29.25	-5.3	72	9010533	5	.84	3' Glass	.194	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
≈10	FT-11	1.79	.980	—	—	I-2	—	15	0.001	6	0.0	1.26	250	250	—	—

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESS DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESS DIFFERENTIAL ACTU	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	0945	000.129									
1	10		5.63	1.0	0.95	0.95	250	78	77	2	259	64
	20		11.37	1.0	1.01	1.01	210	78	76	3	261	64
	30		17.70	1.0	1.03	1.03	200	79	77	3	259	65
	40		23.30	1.0	1.03	1.03	190	81	77	4	261	64
	50		28.94	1.0	1.08	1.08	169	83	78	4	262	66
	60	1045	34.900	1.0	1.08	1.08	168	84	78	4	261	64

? ?-03-046

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant R.R.A.D - Texarkana Sample date 2-28-91

Sample location Afterburner Inlet Recovery date 2-28-91

Run number PIDM-7 Recovered by PF/CB

Filter number(s) 9010531

MOISTURE

Impingers	1	2	3		Silica gel		
Final volume (wt)	602.1	602.2	485.7	ml(g)	Final wt	760.9	g
Initial volume (wt)	605.7	604.2	484.7	ml(g)	Initial wt	754.0	g
Net volume (wt)	-3.6	3.0	1.0	ml(g)	Net wt	6.9	g

Description of impinger water ______ ______ % spent

Total moisture 7.3 g

RECOVERED SAMPLE

Filter container number(s) 11139-B Sealed ✓

Description of particulate on filter Dark Gray

Probe rinse container no. 11139-A Liquid level marked /

Acetone blank container no. 12209-A Liquid level marked /

Impinger contents container no. 11140-A Liquid level marked /

HNO_3 blank container no. 12211-A Liquid level marked /

Samples stored and locked ______

Remarks Soln HNO_3, H_2O_2 Blank = 12212-A

LABORATORY CUSTODY

Received by [signature] Date 3/5/91

Remarks ______

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
RRAD - Texarkana	2/28/91	AB Inlet	Part. / Metals	AIPM-8

OPERATOR(S)	BAR PRESS. (in Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
SB	29.75	-5.3	72	9010532	5		.84	3' Glass	.194	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
10	FT-11	1.79	.980	—	—	I-2	—	16	0.0	4	0.001	1.26	250	250	—	—

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (T_s), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1153	46.023									
1	10		52.90	1.0	1.27	1.27	74	80	78	3	255	62
2	20		58.45	1.0	0.96	0.96	249	81	78	4	256	63
3	30		64.10	1.0	0.95	0.95	253	83	78	4	257	62
4	40		70.25	1.0	0.95	0.95	257	85	79	2	254	61
5	50		75.31	1.0	0.95	0.95	260	87	80	2	255	66
6	60	1253	80.973	1.0	0.95	0.95	260	87	81	2	256	68

Y-03-046

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant R.R.A.D. - TEXARKANA Sample date 2-28-91

Sample location AFTERBURNER INLET Recovery date 2-28-91

Run number ALNM - 8 Recovered by ______

Filter number(s) 9010532

MOISTURE

Impingers	1	2	3		Silica gel	771.9	
Final volume (wt)	600.4	596.8	484.5	ml (g)	Final wt	74	g
Initial volume (wt)	603.4	593.8	483.6	ml (g)	Initial wt	762.4	g (incl. cans)
Net volume (wt)	-3.2	3	0.9	ml (g)	Net wt	9.5	g

Description of impinger water - yellowish - 30 % spent

Total moisture 10.2 g

RECOVERED SAMPLE

Filter container number(s) 11145-B Sealed ✓

Description of particulate on filter ______

Probe rinse container no. 11145-A Liquid level marked ✓

ACETONE blank container no. 12209-A Liquid level marked ✓

Impinger contents container no. 11146-A Liquid level marked ✓

HNO_3 blank container no. 12211-A Liquid level marked ✓

Samples stored and locked ______

Remarks $HNO_3 + H_2O_2$ SOLUTION BLANK 12212-A

LABORATORY CUSTODY

Received by Jon Handleman Date 3/5/91

Remarks ______

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
KR*D - Texarkana	2/26/91	Venturi Inlet	Part/Metals	5IPM-1

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
SB	30.06	-5.9	70	9070054	6"		.84	3' Glass	.171	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
10	FT-4	2.03	.974	270	501	I-5	—	17	0.002	5	0.0	.889	250	250	/	/

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft³	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	0923	726.931									
A-1	20		740.52	1.9	1.64	1.64	80	66	68	2	251	72
2	40		752.60	1.5	1.29	1.29	84	68	68	2	259	66
3	60		766.62	1.9	1.61	1.61	100	73	72	2	256	69
4	80		780.55	2.3	1.83	1.83	138	78	74	2	259	66
5	100		797.90	3.5	2.79	2.79	139	80	76	3	272	69
6	120	1123	815.669	3.4	2.72	2.72	138	82	77	4	272	69
			Vm = 88.738	Δp = 1.535	Avg = 1.90		113	Ave	73.5			
		ml = 385.1										
			$V_{m_{std}}$ = 86.356									
			B_{ws} = 17.3%									

A1-03-053

MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant R.R.A.D. - Texarkana Sample date 2/26/91

Sample location VENTURI INLET Recovery date 2/26/91

Run number SIPM-1 Recovered by (SB)/PF

Filter number(s) 9070054

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	857.1	709.7	524.7	ml (g)	Final wt	823.6		g
Initial volume (wt)	604.6	630.1	506.4	ml (g)	Initial wt	788.9	NA	g
Net volume (wt)	252.5	79.6	18.3	ml (g)	Net wt	34.7		g

Description of impinger water clear 90 % spent

Total moisture 385.1 g

RECOVERED SAMPLE

Filter container number(s) 12219-B Sealed ✓

Description of particulate on filter light Tan

Acetone probe rinse container no. 12213-A Liquid level marked ✓

Impinger contents (1+2) container no. 12214-A Liquid level marked ✓

HNO_3/H_2O_2 blank container no. 12211-A Liquid level marked ✓

Impinger contents (3+4) container no. NA Liquid level marked —

$KMnO_4$ blank container no. NA Liquid level marked —

Samples stored and locked ✓

Remarks Acetone Blank: 12209-A

LABORATORY CUSTODY

Received by [signature] Date 3/5/91

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
RRAD - Texarkana	2/26/91	Venturi Inlet	Part. / Metals	SIPM-2

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
83	30.06	-5.9	70	9070063	6		.84	2' 6/glass	.171	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
17	FT4	2.03	.974	270	501	I-5		15	.001	5	0.0	.777	250	250	—	—

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft³	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1427	815.985									
A 1	10		823.84	2.9	2.16	2.16	98	77	75	3	269	62
2	20		831.[illegible]	2.7	1.99	1.99	106	78	75	3	267	61
3	30		838.37	2.1	1.58	1.58	97	80	76	3	259	62
4	40		846.76	3.7	2.63	2.63	129	81	77	3	264	63
5	50		856.50	4.9	3.46	3.46	133	83	78	5	265	62
6	60	1527	866.432	4.8	3.40	3.40	134	85	79	5	266	61
			V_m = 50.447		Avg =	2.54		Avg = 79				
			$V_{m_{std}}$ 48.66									
			B_{ws} = .162									

X1-03-053

MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant RRAD - Texarkana Sample date 2/26/91

Sample location Venturi Inlet Recovery date 2/26/91

Run number 5IPM-2 Recovered by SB

Filter number(s) 9070063

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	735.3	623.4	499.4	ml (g)	Final wt	773.4		g
Initial volume (wt)	604.4	584.8	494.6	ml (g)	Initial wt	751.7	NA	g
Net volume (wt)	130.9	38.6	4.8	ml (g)	Net wt	21.7		g

Description of impinger water Clear 80 % spent

Total moisture 196 g

RECOVERED SAMPLE

Filter container number(s) 11078-B Sealed ✓

Description of particulate on filter Light beige color

Acetone probe rinse container no. 11078-A ~~12204-A~~ Liquid level marked ✓

Impinger contents (1+2) container no. 11079-A Liquid level marked ✓

HNO_3/H_2O_2 blank container no. 12211-A Liquid level marked ✓

Impinger contents (3+4) container no. NA Liquid level marked

$KMnO_4$ blank container no. NA Liquid level marked ✓

Samples stored and locked

Remarks Acetone Blank - 12209-A

LABORATORY CUSTODY

Received by Jim Anderson Date 3/5/91

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
RRAD - Texarkana	2/27/91	Venturi Inlet	Part/Metals	3IPM-3

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
B	29.97	-5.9	70	9070085	6		.84	3' Glass	.171	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
15	FT-4	2.03	.974	270	501	I-5	—	16	0.001	5	0.0	0.787	250	250	—	—

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	0807	866.588	2.2	1.65	1.65	99	75	73	3	267	62
1	10		873.85	3.0	2.33	2.33	90	76	72	6	261	59
2	20		882.15	2.5	1.86	1.86	105	78	72	3	262	60
3	30		889.50	3.4	2.43	2.43	128	79	72	4	261	61
4	40		897.62	4.5	3.22	3.22	128	80	74	5	266	62
5	50		907.20	4.5	3.22	3.22	128	82	75	5	261	64
6	60	0907	916.809									

X1-03-053

MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant RRAD - TEXARKANA Sample date 2/27/91

Sample location VENTURI - INLET Recovery date 2/27/91

Run number SIPM-3 Recovered by (83)/PF

Filter number(s) 9070085

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	692.7	638.3	496.6	ml (g)	Final wt	740.6		g
Initial volume (wt)	608.0	591.3	484.8	ml (g)	Initial wt	720.2		g
Net volume (wt)	84.7	47.0	11.8	ml (g)	Net wt	20.4		g

Description of impinger water ______ 70 % spent

YELLOWISH TINT

Total moisture 163.9 g

RECOVERED SAMPLE

Filter container number(s) 11121-B Sealed ✓

Description of particulate on filter Very light brown

Acetone probe rinse container no. 11121-A Liquid level marked ✓

Impinger contents (1+2) container no. 11122-A Liquid level marked ✓

HNO_3/H_2O_2 blank container no. 12212-A Liquid level marked ✓

Impinger contents (3+4) container no. — Liquid level marked —

$KMnO_4$ blank container no. — Liquid level marked —

Samples stored and locked ✓

Remarks

LABORATORY CUSTODY

Received by [signature] Date 3/5/91

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
KRAD - Texarkana	2/27/91	Venturi Inlet	Part/Metals	SIPM-4

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
83	29.97	-5.9	72	9070038	6		.84	3' Glass	.171	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
15	FT-4	2.03	.974	270	501	I-5		16	0.001	6	0.002	0.747	250	250	/	/

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (T_s), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1037	916.936									
1	10		923.55	2.0	1.50	1.50	101	79	75	2	259	69
2	20		931.11	2.7	2.07	2.07	91	79	74	2	260	67
3	30		937.75	2.0	1.45	1.45	120	80	75	2	259	66
4	40		946.84	3.3	2.37	2.37	128	81	76	3	261	64
5	50		955.00	4.2	3.01	3.01	129	81	77	4	266	65
6	60	1137	964.394	4.3	3.09	3.09	129	82	78	4	264	66

N1-03-03

MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant NRRD - TEXARKANA Sample date 2/27/91

Sample location VENTURI - INLET Recovery date 2/27/91

Run number SIPM- 4 Recovered by PF

Filter number(s) 9070038

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	709.2	637.9	486.3	ml (g)	Final wt	755.2		g
Initial volume (wt)	592.4	613.6	483.7	ml (g)	Initial wt	743.0		g
Net volume (wt)	116.8	24.3	2.6	ml (g)	Net wt	12.2		g

Description of impinger water Clear 50 % spent

Total moisture 155.9 g

RECOVERED SAMPLE

Filter container number(s) 11123-B Sealed ✓

Description of particulate on filter

Acetone probe rinse container no. 11123-A Liquid level marked ✓

Impinger contents (1+2) container no. 11124-A Liquid level marked ✓

HNO_3/H_2O_2 blank container no. 12212-A Liquid level marked ✓

Impinger contents (3+4) container no. — Liquid level marked

$KMnO_4$ blank container no. — Liquid level marked

Samples stored and locked ✓

Remarks

LABORATORY CUSTODY

Received by Jim Hamblin Date 3/5/91

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
RRHD - Texarkana,	2/27/91	Venturi INleT	Part /Metals	SIPM-5

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
(ES)	29.97	-5.9	72	9010500	6		.54	3' Glass	.171	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
15	FT-4	2.03	.974	270	501	I-5		16	0.001	6	0.001	0.787	250	250	—	—

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1329	964.628									
1	10		972.20	2.7	2.05	2.05	97	79	75	3	261	64
2	20		979.73	2.6	1.92	1.92	114	79	76	3	261	63
3	30		987.20	2.6	1.88	1.88	125	80	76	3	262	62
4	40		996.10	3.5	2.50	2.50	133	82	77	3	259	63
5	50		1004.60	3.9	2.79	2.79	133	82	78	4	258	66
6	60	1429	1013.863	4.1	2.94	2.94	133	84	79	5	256	67

XI-03-053

MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant R.R.A.D. - TEXARKANA Sample date 2/27/91

Sample location VENTURI · INLET Recovery date 2/27/91

Run number SIAM-5 Recovered by DB/PF

Filter number(s) 9010500

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	745.9	629.6	488.3	ml (g)	Final wt	766.5		g
Initial volume (wt)	606.5	605.5	485.3	ml (g)	Initial wt	749.3		g
Net volume (wt)	139.4	24.1	3	ml (g)	Net wt	17.2		g

Description of impinger water clear 70 % spent

Total moisture 183.7 g

RECOVERED SAMPLE

Filter container number(s) 1113/-B Sealed ✓

Description of particulate on filter

Acetone probe rinse container no. 1113/-A Liquid level marked ✓

Impinger contents (1+2) container no. 1113 2-A Liquid level marked ✓

HNO_3/H_2O_2 blank container no. 1221 2-A Liquid level marked ✓

Impinger contents (3+4) container no. — Liquid level marked

$KMnO_4$ blank container no. — Liquid level marked

Samples stored and locked ✓

Remarks

LABORATORY CUSTODY

Received by [signature] Date 3/5/91

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
R.R.A.D. - Texarkana	2/06/91	Venturi Outlet	Part/Metals	50PM-1

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
SB	30.06	T0.05	70	9070069 and 9070053	9		.84	3' Glass	.252	

MOISTURE (%) >	METER BOX NO.	METER ΔH@	METER CAL FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR 2.819	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
10	FT-2	1.41	.992	109	140	I-32	—	16	0.001	16	0.003	2.[illegible]	250	250	✓	✓

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (Tm in), °F	OUTLET (Tm out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	0922	829.154									
A-1	15		838.17	.26	.67	.67	123	73	73	2	250	70
2	30	0955	846.596	.35	.89	.89	134	78	74	13	300	68
3	45		855.74	.34	0.87	0.87	134	78	77	15	300	69
4	60	1042	864.735	.31	0.80	0.80	131	84	77	11	300	70
~~5~~												
~~6~~												
B 1	75		874.39	.32	0.82	0.82	132	82	80	8	305	72
2	90		883.01	.33	0.86	0.86	131	87	80	6	301	62
3	105	1142	892.157	.34	0.88	0.88	131	90	80	6	303	64
~~4~~	~~120~~											
			Vm = 63.003	$\sqrt{\Delta p}$ = .566	ave =	.827	131	ave = 80°F				
			Vmstd = 61.520									
			Bws = .43%									

* probe short — change probe 0965

L.C. Vol. 846.677

X1-03-~~053~~ 055

MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant RAAD - Texarkana Sample date 2/26/91

Sample location Venturi outlet Recovery date 2/26/91

Run number 50 PM-1 Recovered by (83)/DF

Filter number(s) 9070053 and 9070069

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	860.7	907.8	874.8	ml (g)	Final wt	725.3	NA	g
Initial volume (wt)	591.8	611.2	476.3	ml (g)	Initial wt	690.3	NA	g
Net volume (wt)	268.9	296.6	398.5	ml (g)	Net wt	35		g

Description of impinger water Clear 100 % spent

Total moisture 999.0 g

RECOVERED SAMPLE

Filter container number(s) 9070053 -B 9070069 -B Sealed ✓

Description of particulate on filter Both filters wet; dirty

Acetone probe rinse container no. 11075-A 11054-A Liquid level marked ✓

Impinger contents (1+2) container no. 12215-A Liquid level marked ✓

HNO_3/H_2O_2 blank container no. 11074-A 12212-A Liquid level marked ✓

Impinger contents (3+4) container no. NA Liquid level marked —

$KMnO_4$ blank container no. NA Liquid level marked —

Samples stored and locked

Remarks Blank Filter No. 9070094 (Cont. # 11074-B)
Acetone Blank: 12209-A

LABORATORY CUSTODY

Received by Jim Anderson Date 3/5/91

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
RRAD - TexarKana	2/26/91	Venturi Outlet	Part./Metals	50PM-2

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
SB	30.06	+.05	70	9070066	9		.84	3' Glass	.252	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
43	FT-2	1.41	.992	~~220~~ 105	140	I-32	—	16	0.0	5	0.8	1.32	250	250	/	/

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1430	892.532									
A 1	7.5		895.61	.40	0.49	0.49	127	80	82	3	290	66
2	15		900.30	.46	0.57	0.57	119	82	79	3	291	64
3	22.5		903.65	.44	0.53	0.53	132	85	80	4	288	65
4	30		907.[illegible]	.31	0.38	0.38	133	88	80	5	271	64
B 1	37.5		909.89	.30	0.37	0.37	126	85	80	4	298	63
2	45		913.64	.34 ~~.30~~	0.42	0.42	126	85	80	4	288	63
3	52.5		917.21	.41 ~~.34~~	0.52	0.52	127	89	82	4	269	66
4	60	1535	920.633	.38	0.47	0.47	127	92	83	4	266	68
			Vm = 28.101	A	Av = .469			Ave. = 83.1				
			$V_{m_{std}}$ = 25.937									
			Bw = 12%									

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MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant KRAD - TEXARKANA Sample date 2/26/91

Sample location VENTURI OUTLET Recovery date 2/26/91

Run number SOAM-2 Recovered by (83)

Filter number(s) 90700066

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	662.3	599.7	497.1	ml (g)	Final wt	755.5		g
Initial volume (wt)	608.2	588.1	495.6	ml (g)	Initial wt	747.9	N/A	g
Net volume (wt)	54.1	11.6	1.5	ml (g)	Net wt	7.6		g

Description of impinger water Clear 10 % spent

Total moisture 74.8 g

RECOVERED SAMPLE

Filter container number(s) 11076-B Sealed ✓

Description of particulate on filter Very light tan

ACETONE probe rinse container no. 11076-A ~~12209-A~~ Liquid level marked ✓

Impinger contents (1+2) container no. 11077-A Liquid level marked ✓

HNO_3/H_2O_2 blank container no. 12211-A Liquid level marked ✓

Impinger contents (3+4) container no. NA Liquid level marked

$KMnO_4$ blank container no. NA Liquid level marked

Samples stored and locked ✓

Remarks

LABORATORY CUSTODY

Received by [signature] Date 3/5/91

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
RRAD - Texarkana, Tx.	2/27/91	Venturi Outlet	Part./Metals	5OPM-3

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	Glass NOZZLE I.D.	NOZZLE NUMBER
SB	29.97	+.05	70	9070093	9		.94	3' Glass	.252	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
15	FT-2	1.41	.992	109	140	I-32	—	16	0.001	6	0.0	2.61	270	270	/	/

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft³	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	0808	920.771	.33	0.78	0.78	130	75	75	4	279	60
A 1	7.5		925.15	.35	0.82	0.82	134	77	75	4	278	58
2	15		929.73	.37	0.88	0.88	131	80	75	4	277	59
3	22.5		934.48	.40	0.96	0.96	123	83	75	4	267	61
4	30	0838	939.437	.35	0.85	0.85	121	82	76	4	266	63
B 1	37.5		944.10	.36	0.88	0.88	121	87	77	4	261	64
2	45		948.81	.40	0.98	0.78	120	88	78	4	267	65
3	52.5		953.76	.43	1.05	1.05	120	90	79	4	268	66
4	60	0914	959.167									

X1-03-~~053~~ 055

MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant AAAP - TEXARKANA Sample date 2/27/91

Sample location VENTURI OUTLET Recovery date 2/27/91

Run number 50PM-3 Recovered by AF/CB

Filter number(s) 5070093

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	656.1	654.3 ~~629.3~~	512.4	ml (g)	Final wt	782.4 ~~282.4~~	NA	g
Initial volume (wt)	606.6	~~628.3~~	507.8	ml (g)	Initial wt	76.9	NA	g
Net volume (wt)	49.5	26	4.6	ml (g)	Net wt	13.4		g

Description of impinger water ______ 40 % spent

Clear a little cloudy

Total moisture 93.5 g

RECOVERED SAMPLE

Filter container number(s) 11119-B Sealed ✓

Description of particulate on filter LIGHT GRAY

Acetone probe rinse container no. 11119-A Liquid level marked ✓

Impinger contents (1+2) container no. 111120-A Liquid level marked ✓

HNO_3/H_2O_2 blank container no. 12212-A Liquid level marked ✓

Impinger contents (3+4) container no. — Liquid level marked

$KMnO_4$ blank container no. — Liquid level marked

Samples stored and locked

Remarks

LABORATORY CUSTODY

Received by [signature] Date 3/5/91

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
RRAD - Texarkana, Tx.	2/27/91	Venturi OUTLET	PART. /Metals	SOPM-4

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
SB	29.97	+0.05	72	9070021	9		.84	4' Glass	.252	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
15	FT-2	1.41	.992	109	140	I-32	—	15	0.0	23	0.006	2.61	250	250	—	—

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft³	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1034	959.294									
A 1	7.5		962.75	.20	0.48	0.48	124	80	80	7	257	72
2	15		967.25	.33	0.80	0.80	125	82	79	16	261	68
3	22.5		971.70	.43	1.04	0.76	122	85	79	22	261	66
4	30	1104	976.095	.39	0.95	0.77	121	85	81	22	260	64
							~~121~~	~~83~~	~~82~~			
B 1	37.5		980.621	.29	0.71	0.71	121	83	82	14	269	65
2	45		985.35	.33	0.80	0.80	122	85	81	16	261	66
3	52.5		989.88	.35	0.85	0.80	122	86	81	21	266	67
4	60	1139	993.908	.38	0.93	0.78	121	88	81	22	261	68

* 2nd Imp. problem; restricted flow.

X1-03-~~053~~ 055

MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant KRAD - TEXARKANA Sample date 2/27/91

Sample location VENTURI OUTLET Recovery date 2/27/91

Run number SCPM-4 Recovered by (BB)/PF

Filter number(s) 9070021

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	664.9	581.4	507.5	ml (g)	Final wt	748.2		g
Initial volume (wt)	600.2	576.3	501.0	ml (g)	Initial wt	732.8		g
Net volume (wt)	64.7	5.1	3.5	ml (g)	Net wt	15.4		g

Description of impinger water Clear

40 % spent

Total moisture 88.7 g

RECOVERED SAMPLE

Filter container number(s) 11127-B Sealed ✓

Description of particulate on filter light beige color

Acetone probe rinse container no. 11127-A Liquid level marked ✓

Impinger contents (1+2) container no. 11128-A Liquid level marked ✓

HNO_3/H_2O_2 blank container no. 12212-A Liquid level marked ✓

Impinger contents (3+4) container no. Liquid level marked

$KMnO_4$ blank container no. Liquid level marked

Samples stored and locked

Remarks

LABORATORY CUSTODY

Received by [signature] Date 3/5/91

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
KRAD - Texarkana, TX	2/27/91	Venturi Outlet	Part/Metals	50PM-5

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
83	29.97	+.05	72	9010493	9		.84	3' Glass	.252	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
15	FT-2	1.41	.992	109	140	I-32	—	15	0.0	5	0.0	2.61	250	250	—	—

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (T_s), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1327	994.142									
A-1	7.5		998.70	.33	~~.798~~ .784	[illegible]	128	81	82	4	268	64
2	15		1003.28	.34	.91	.91	131	83	81	4	271	65
3	22.5		1008.35	.37	0.90	0.90	128	57	81	4	262	66
4	30	1357	1013.153	.41	1.00	1.00	125	90	82	4	269	64
B-1	37.5		1017.66	.32	0.78	0.78	126	87	82	4	262	66
2	45		1022.40	.35	0.86	0.86	125	92	84	4	261	64
3	52.5		1027.45	.38	0.93	0.93	126	95	85	4	262	63
4	60	1432	1032.437	.40	0.98	0.98	126	95	85	4	261	64

XI-03-055

MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant R.R.A.D -TEXARKANA Sample date 2/27/91

Sample location VENTURI OUTLET Recovery date 2/27/91

Run number 30PM-5 Recovered by PF/83

Filter number(s) 90U493

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	684.5	649.9	510.8	ml (g)	Final wt	792.4		g
Initial volume (wt)	611.7	625.2	512.4	ml (g)	Initial wt	782.4		g
Net volume (wt)	72.8	24.7	-1.6	ml (g)	Net wt	10		g

Description of impinger water Clear 60 % spent

Total moisture 105.9 g

RECOVERED SAMPLE

Filter container number(s) 11129-B Sealed /

Description of particulate on filter Light (barely visible)

Acetone probe rinse container no. 11129-A Liquid level marked /

Impinger contents (1+2) container no. 11130-A Liquid level marked /

HNO_3/H_2O_2 blank container no. 12212-A Liquid level marked /

Impinger contents (3+4) container no. — Liquid level marked

$KMnO_4$ blank container no. — Liquid level marked

Samples stored and locked /

Remarks

LABORATORY CUSTODY

Received by [signature] Date 3/5/91

Remarks

Fyrite: O_2 - 20%. CO_2 - 1.0%.

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
ARAD - Texarkana	2/28/91	Venturi Outlet	Part/Metals	50PM-6

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
(83)	29.75	1.05	72	9010503	9		.84	4' Glass	.252	3-109

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INT.	PITOT LEAK CHECK FIN'L
16	FT-2	1.41	.992	109	140	I-32	—	16	0.002	6	0.001	2.56	250	250	/	/

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (ΔP_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (T_s), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	0800	32.738									
A-1	7.5		37.03	.31	0.72	0.72	131	75	75	3	259	66
2	15		41.52	.34	0.79	0.79	130	77	75	4	261	64
3	22.5		46.26	.39	0.91	0.91	128	81	76	3	262	64
4	30	0832	51.171	.41	0.96	0.96	128	85	76	4	261	62
B-1	37.5		55.00	.32	0.76	0.76	127	85	78	3	258	63
2	45		60.[illegible]	.36	0.85	0.85	129	88	78	3	261	64
3	52.5		65.43	.40	0.95	0.95	130	90	79	4	262	65
4	60		70.570	.42	1.00	1.00	130	92	80	4	261	64

21-03-055

LEAD SAMPLE RECOVERY AND INTEGRITY SHEET

Plant RRAD - TEXARKANA Sample date 2/28/91

Sample location VENTURI OUTLET Recovery date 2/28/91

Run number SCRM- 6 Recovered by SB/PF

Filter number(s) 9c10503

MOISTURE

Impingers	1	2	3		Silica gel		
Final volume (wt)	672.5	648.7	597.1	ml (g)	Final wt	748.0	g
Initial volume (wt)	587.8	628.1	594.6	ml (g)	Initial wt	737.2	g
Net volume (wt)	89.7	20.6	2.5	ml (g)	Net wt	10.8	g

Description of impinger water Clear 70 % spent

Total moisture 123.6 g

RECOVERED SAMPLE

Filter container number(s) 11135-B Sealed ✓

Description of particulate on filter

Acetone probe rinse container no.	11135-A	Liquid level marked	✓
Acetone blank container no.	12209-A	Liquid level marked	✓
0.1 N HNO_3 probe rinse container no.	NA	Liquid level marked	
Impinger contents container no.	11136-A	Liquid level marked	✓
0.1 N HNO_3 blank container no.		Liquid level marked	

Samples stored and locked

Remarks HNO_3 BLANK - 12211-A FILTER BLANK - 11126B

SOL: HNO_3, H_2O_2 BLANK - 12212A

LABORATORY CUSTODY

Received by [signature] Date 3/5/91

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
RRAD - Texarkana	2/28/91	Venturi Outlet	Part. / Metals	50PM-7

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
83	29.75	+.05	72	401 0488	9		.84	4' Glass	.252	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K' FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
15	FT-2	1.41	.992	109	140	I-32	-	15	0.001	5	0.003	2.56	250	250	—	—

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft³	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	0945	70.700									
A-1	7.5		75.14	.31	0.74	0.74	124	81	81	4	269	62
2	15		79.75	.34	0.81	0.81	125	83	81	4	266	63
3	22.5		84.65	.39	0.93	0.93	124	89	81	4	263	62
4	30		89.667	.42	1.00	1.00	125	92	82	4	259	63
B-1	37.5		94.25	.33	0.79	0.79	124	87	83	4	261	62
2	45		99.13	.38	0.91	0.91	126	93	83	3	259	64
3	52.5		104.36	.41	0.98	0.98	125	94	83	4	269	66
4	60	10	109.162	.42	1.01	1.01	126	95	84	4	262	64

X1-03-055

MULTIMETALS SAMPLE RECOVERY AND INTEGRITY SHEET

Plant R.R.A.D - Texarkana Sample date 2-28-91

Sample location Venturi outlet Recovery date 2-28-91

Run number 50AA-7 Recovered by PF/CB

Filter number(s) 9010488

MOISTURE

Impingers	1	2	3			4	5	
Final volume (wt)	688.4	609.1	503.0	ml (g)	Final wt	779.6	NA	g
Initial volume (wt)	604.2	589.9	501.1	ml (g)	Initial wt	770.4	NA	g
Net volume (wt)	84.2	19.2	1.9	ml (g)	Net wt	9.2		g

Description of impinger water Clear 50 % spent

Total moisture 114.5 g

RECOVERED SAMPLE

Filter container number(s) 11141-B Sealed ✓

Description of particulate on filter Light gray

Acetone probe rinse container no. 11141-A Liquid level marked ✓

Impinger contents (1+2) container no. Liquid level marked

HNO_3/H_2O_2 blank container no. 12212-A Liquid level marked ✓

Impinger contents ~~(3+4)~~ ALL container no. 11142-A Liquid level marked ✓

$KMnO_4$ blank container no. Liquid level marked

Samples stored and locked

Remarks Acetone blank 12209-A HNO_3 Blank - 12211-A

LABORATORY CUSTODY

Received by Jim Anderson Date 3/5/91

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
RRAD - Texarkana	2/28/91	Venturi Outlet	Part./Metals	SOPM-8

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
83	29.75	+.05	72	9010533	9		.84	3' Glass	.252	

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) in. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) in. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
15	FT-2	1.41	.992	109	140	I-32	—	15	0.001	6	0.001	2.56	250	250	✓	✓

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1128	109.330									
A1	7.5		113.56	0.28	0.67	0.67	126	84	84	2	258	63
2	15		118.00	0.32	0.76	0.76	125	86	83	3	259	56
3	22.5		122.80	0.39	0.93	0.93	125	89	83	3	261	54
4	30		127.885	0.42	1.01	1.01	125	91	82	3	262	52
B1	37.5		132.20	.30	0.71	0.71	126	87	82	3	251	54
2	45		136.83	.35	0.84	0.84	125	91	83	3	25[illegible]	61
3	52.5		141.80	.40	0.97	0.97	123	94	83	3	[illegible]	68
4	60	1252	146.823	.42	1.01	1.01	124	96	84	3	250	67

X1-03-055

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant R.R.A.D - TEXARKANA Sample date 2-28-91

Sample location VENTURI OUTLET Recovery date 2-28-91

Run number SOAM - 8 Recovered by PF

Filter number(s) 9010533

MOISTURE

Impingers	1	2	3		Silica gel		
Final volume (wt)	665.7	641.6	506.8	ml(g)	Final wt	757.1	g
Initial volume (wt)	583.5	626.3	505.0	ml(g)	Initial wt	747.9	g
Net volume (wt)	82.2	15.3	1.8	ml(g)	Net wt	9.2	g

Description of impinger water Clear

70 % spent

Total moisture 108.5 g

RECOVERED SAMPLE

Filter container number(s) 11143 Sealed ✓

Description of particulate on filter

Probe rinse container no. 11143-A Liquid level marked ✓

Acetone blank container no. 12209-A Liquid level marked ✓

Impinger contents container no. 11144-A Liquid level marked ✓

HNO_3 blank container no. 12211-A Liquid level marked ✓

Samples stored and locked

Remarks HNO_3 + H_2O_2 SOLUTION BLANK 12212-A

LABORATORY CUSTODY

Received by [signature] Date 3/6/91

Remarks

INITIAL CEM CALIBRATION AND PERFORMANCE EVALUATION

Plant	Red River Army Depot	Parameter	SO_2, CO_2, O_2, NO_x, THC
Location	Texarkana	Monitor	Beckman 402
Date	8-25-91	Span value	ppm or % 517.8
Operator	R Fitzgerald	Chart scale	100
PN	80-625	Pbar, in.Hg	30.09

Cylinder No.	Cal. gas conc., ppm or %	Chart divisions: Direct injection to monitor	Chart divisions: Injection through system	Concentration predicted by equation,* Direct	Concentration predicted by equation,* System	Calibration error,** % of span (Direct)	Calibration error,** % of span (System)	Sampling system bias,*** % of span
ALM 005342	503	92.5	94.0	504.7	513.3	-.3	-1.9	-1.6
ALM 005755	300	56.5	58.5	297.5	309.0	.5	-1.6	-2.1
ALM 010010	101	22.3	24.3	100.7	112.3	.05	-2.1	-2.1
AAL 3691	0	5.0	7.0	1.2	12.7	-.2	-2.3	-2.1

* Perform linear regression of pretest cal. gas concentration vs. chart divisions to determine following equation:

$y = mx + b$ x = ppm y = chart division

For data reduction:

$$\text{Pollutant ppm/\%} = \frac{(\text{Chart division} - b)}{m} = \frac{(CD - 4.79)}{(.1738)}$$

Correlation coef. = .9999

Calculation concentration predicted by equation using actual chart response obtained from each calibration gas response.

$$\text{** Calibration error, \% span} = \frac{(\text{Concentration of cal. gas, ppm} - \text{predicted conc., ppm})}{\text{Span, ppm}} \times 100$$

Acceptable limit = ±2% each gas (THC limit is ±5%).

*** Sampling system bias =

$$\frac{(\text{Direct injection gas conc.} - \text{system injection gas conc.}) \times 100}{\text{Span value}}$$

Acceptable limit $\leq$5% of span

Minimum detectable limit = 2 percent of span or 11.0 ppm or % (circle one)

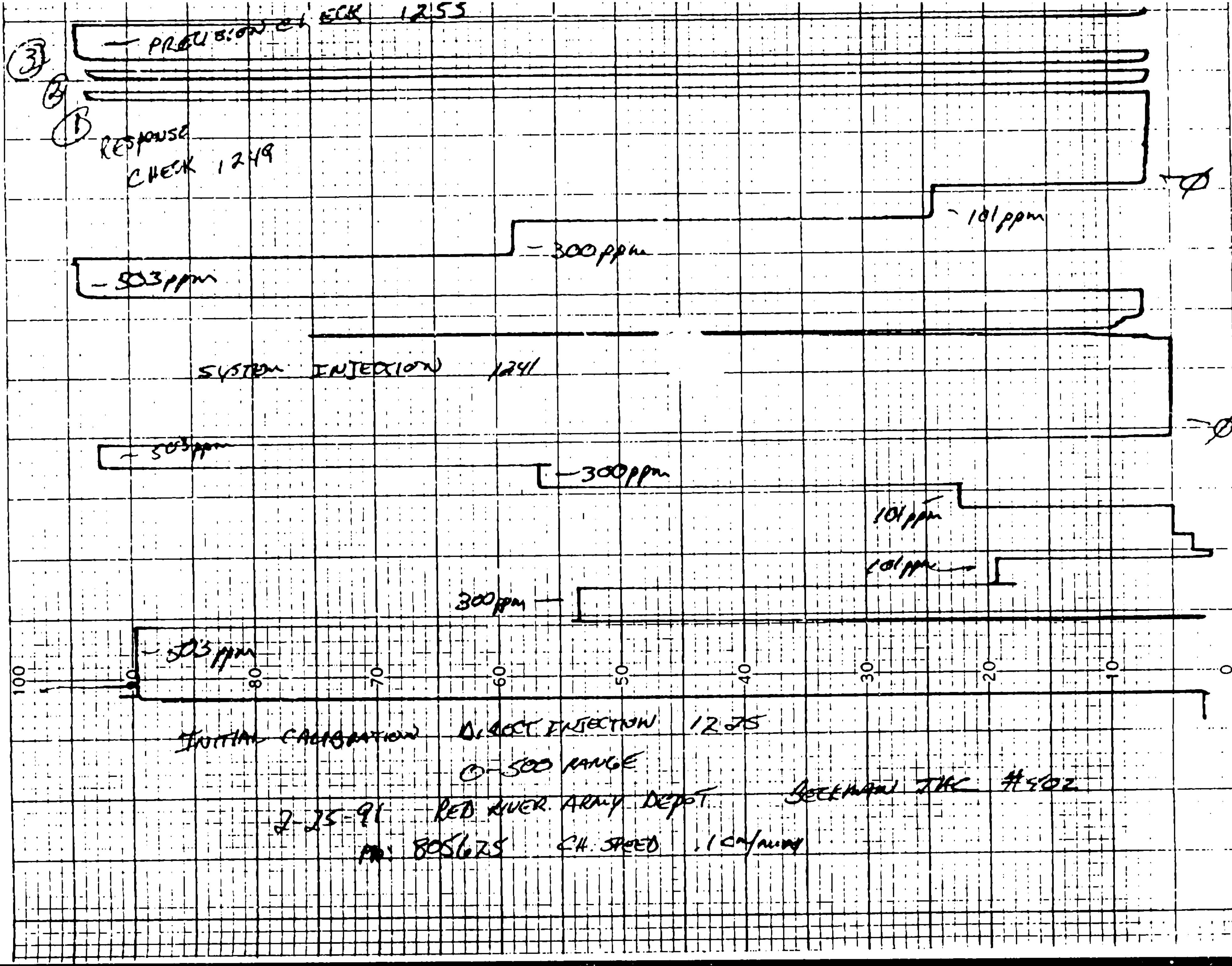
Rise time to 95% of response for high cal. gas injected through system (return to zero after each injection):

28 s, 28 s, 28 s Avg. 28 s

Precision, % scale = difference in chart division response for two repeated injections of the same gas concentration = 94.0 - 94.3 = .3 %
(clock time = 1253)

COMMENTS:

DS 3-28-91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3
2
1
RESPONSE CHECK 1249
101 ppm
300 ppm
503 ppm
SYSTEM INJECTION 1241
503 ppm
300 ppm
101 ppm
101 ppm
300 ppm
503 ppm
100
90
80
70
60
50
40
30
20
10
0
INITIAL CALIBRATION DIRECT INJECTION 1235
0-500 RANGE
2-25-91 RED RIVER ARMY DEPOT BECKMAN THC #402
805625 CH. SPEED .1 cm/min
T NO. 445-17

DAILY CEM CALIBRATION AND PERFORMANCE EVALUATION

Plant	R.R.A.D	Parameter	SO_2, CO_2, O_2, NO_x, THC
Location	Texarkana	Monitor	Beckman 402
Date	2-26-91	Span value	ppm or % 119.2
Operator	P. Fitzgerald	Chart scale	100
PN	805625	Pbar, in.Hg	30.06
Time, Pretest 1055 Post-test 1544		Tamb, °F	70°
Run No.	Venturi Inlet		

Cylinder No.	Cal. gas conc., ppm or %	Chart divisions Pretest	Chart divisions Posttest	Concentration predicted by equation* Pretest	Concentration predicted by equation* Posttest	Analyzer calibration error,** % of span	Drift,*** % of span
	101	85.5	85.0	101.1	100.5	.08	.5
	50.8	45.0	45.0	50.5	50.5	.3	0
	20.4	21.0	20.8	20.6	20.3	-.2	~~.3~~ 0.
	0	4.5	4.5	-.01	-.01	.01	0

* Perform linear regression of pretest cal. gas concentration vs. chart divisions to determine following equation:

$y = mx + b$ $x = \text{ppm}$ $y = \text{chart division}$

For data reduction:

$$\text{Pollutant ppm/\%} = \frac{(\text{Chart division} - b)}{m} = \frac{(CD - 4.51)}{(.801)}$$

Correlation coef. = .99999

** Analyzer cal. error, % span = $\frac{(\text{Cal. gas conc.} - \text{conc. predicted}) \times 100}{\text{Span value}}$

Acceptable limit = $\leq$2% of span (±5% for THC).

*** Drift % span = $\frac{(\text{Posttest cal. response} - \text{initial cal. response}) \times 100}{\text{Span value}}$

Acceptable limit $\leq$3% of span

Minimum detectable limit = 2% of span or 2.4 ppm or % (circle one)

Maximum zero drift = 0 % of span or ________ ppm or % (circle one)

Maximum cal. drift = .5 % of span or ________ ppm or % (circle one)

COMMENTS: Pretest or posttest (circle one) calibration used to quantitate sample data. Posttest is used if drift exceeds limits and if posttest yields higher concentrations.

DB 3/28/91

DB 3-28-91

DAILY CEM CALIBRATION AND PERFORMANCE EVALUATION

Plant	Red River Army Depot	Parameter	SO_2, CO_2, O_2, NO_x, THC
Location	Texarkana	Monitor	Beckman 402
Date	2-26-91	Span value	ppm or % 538.0
Operator	A. Fitzgerald	Chart scale	100
PN	805625	Pbar, in.Hg	30.06
Time, Pretest 0805	Post-test	Tamb, °F	70°
Run No.	AEAM-1, SSPM-1, SOPM-2		

Cylinder No.	Cal. gas conc., ppm or %	Chart divisions Pretest	Chart divisions Posttest	Concentration predicted by equation* Pretest	Concentration predicted by equation* Posttest	Analyzer calibration error,** % of span	Drift,*** % of span
ALM 005322	503	94.0		504.0		-.2	
ALM 008755	300	57.8		298.5		.3	
ALM 010010	101	23.0		101.0		0	
AAL 3681	0	5.3		.6		-.1	

* Perform linear regression of pretest cal. gas concentration vs. chart divisions to determine following equation:

$y = mx + b$ $x = \text{ppm}$ $y = \text{chart division}$

For data reduction:

$$\text{Pollutant ppm/\%} = \frac{(\text{Chart division} - b)}{m} = \frac{(CD - 5.20)}{(.1762)}$$

Correlation coef. = .9999

** $\text{Analyzer cal. error, \% span} = \frac{(\text{Cal. gas conc.} - \text{conc. predicted}) \times 100}{\text{Span value}}$

Acceptable limit = $\leq$2% of span (±5% for THC).

*** $\text{Drift \% span} = \frac{(\text{Posttest cal. response} - \text{initial cal. response}) \times 100}{\text{Span value}}$

Acceptable limit $\leq$3% of span

Minimum detectable limit = 2% of span or 10.8 ppm or % (circle one)

Maximum zero drift = ____% of span or ____________ ppm or % (circle one)

Maximum cal. drift = ____% of span or ____________ ppm or % (circle one)

COMMENTS: Pretest or posttest (circle one) calibration used to quantitate sample data. Posttest is used if drift exceeds limits and if posttest yields higher concentrations.

DB 3-20-91

CEM DATA REDUCTION SHEET FOR BAG ANALYSIS OR STEADY READINGS

Date 2-26-91 Parameter SO_2, NO_x,* CO_2, O_2, THC, CO

Operator P Fitzgerald PN 805625 Location VENTURI INLET

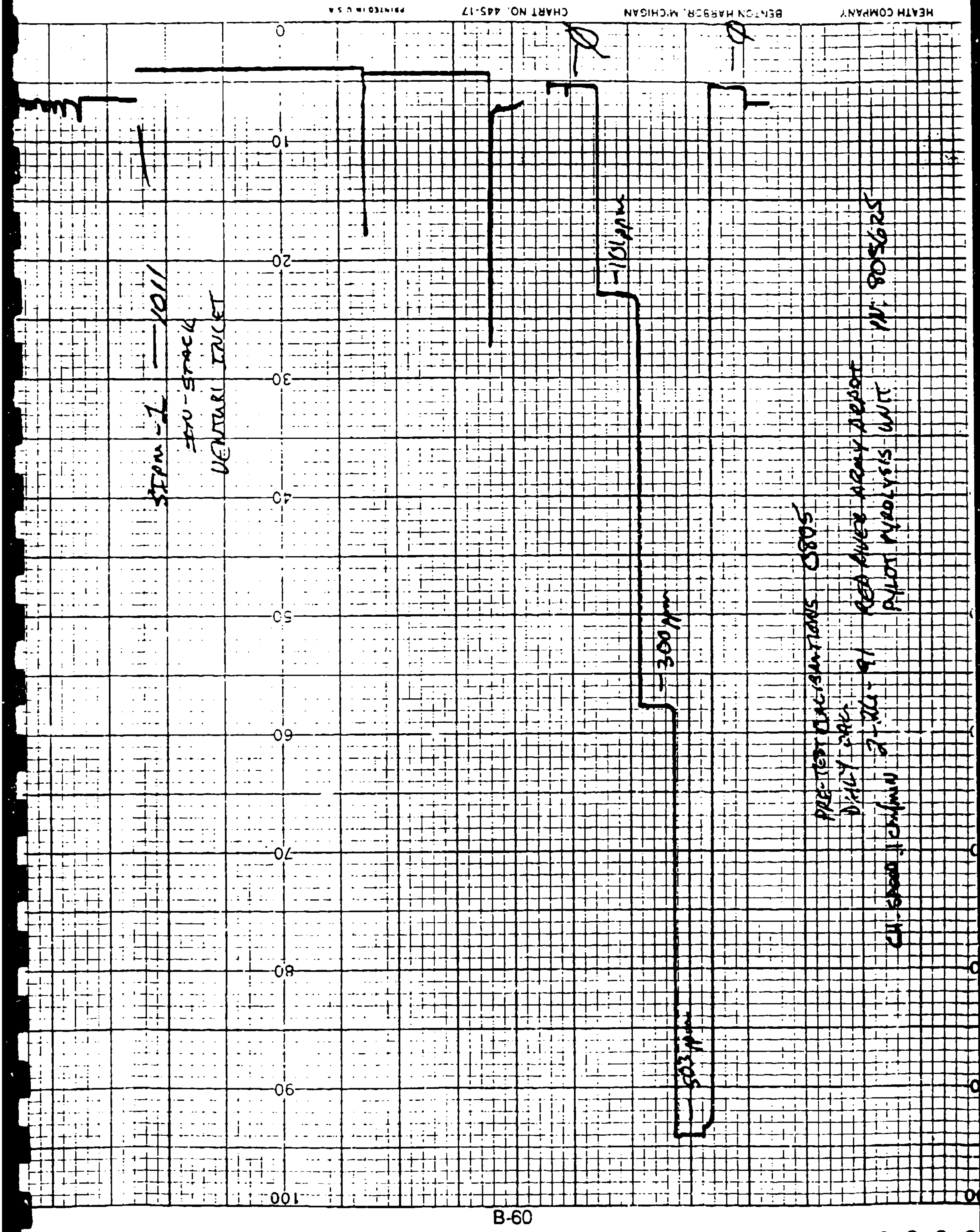
Pollutant ppm/% = $\frac{\text{(Chart division - b)}}{\text{m}}$ = $\frac{(CD - 5.20)}{(.1762)}$ $\frac{CA - 5.51}{.801}$

0.500 → 0-100

Run No.	Time** (24-H)	Average chart division	Conc.	Comments
STAM - 1	1011-1045	6.5	7.4	on 0-500 RANGE
	SWITCH TO 0-100 RANGE			
VENTURI INLET	1106-1305	6.5	~~2.4~~	0-100 RANGE MINIMUM DETECTIBLE LIMIT IS 2.4
			2.5	
	1305-1332	6.5	2.5	
	1332-1429	6.5	2.5	
	1429-1443	8.0	~~19~~ 4.4	@ 1443 THC rose to 14 chart divisions = 11.8 ppm, this gradually decreased to a stable 8.4 ppm reading
	1443 1503	8.0	~~19~~ 4.4	
	1503-1522	6.5	2.5	

* For NO_x indicate whether NO, NO + NO_2, or NO_2 for specific interval.
** Indicate whether time interval is from beginning of first time to beginning of second time or to end of second time (circle one, or describe alternate).

Calculated by P. Fitzgerald on 3-8-91 Checked by D Schaffer on 3-26-91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BENTON HARBOR, MICHIGAN
CHART NO. 445-17
PRINTED IN U.S.A.
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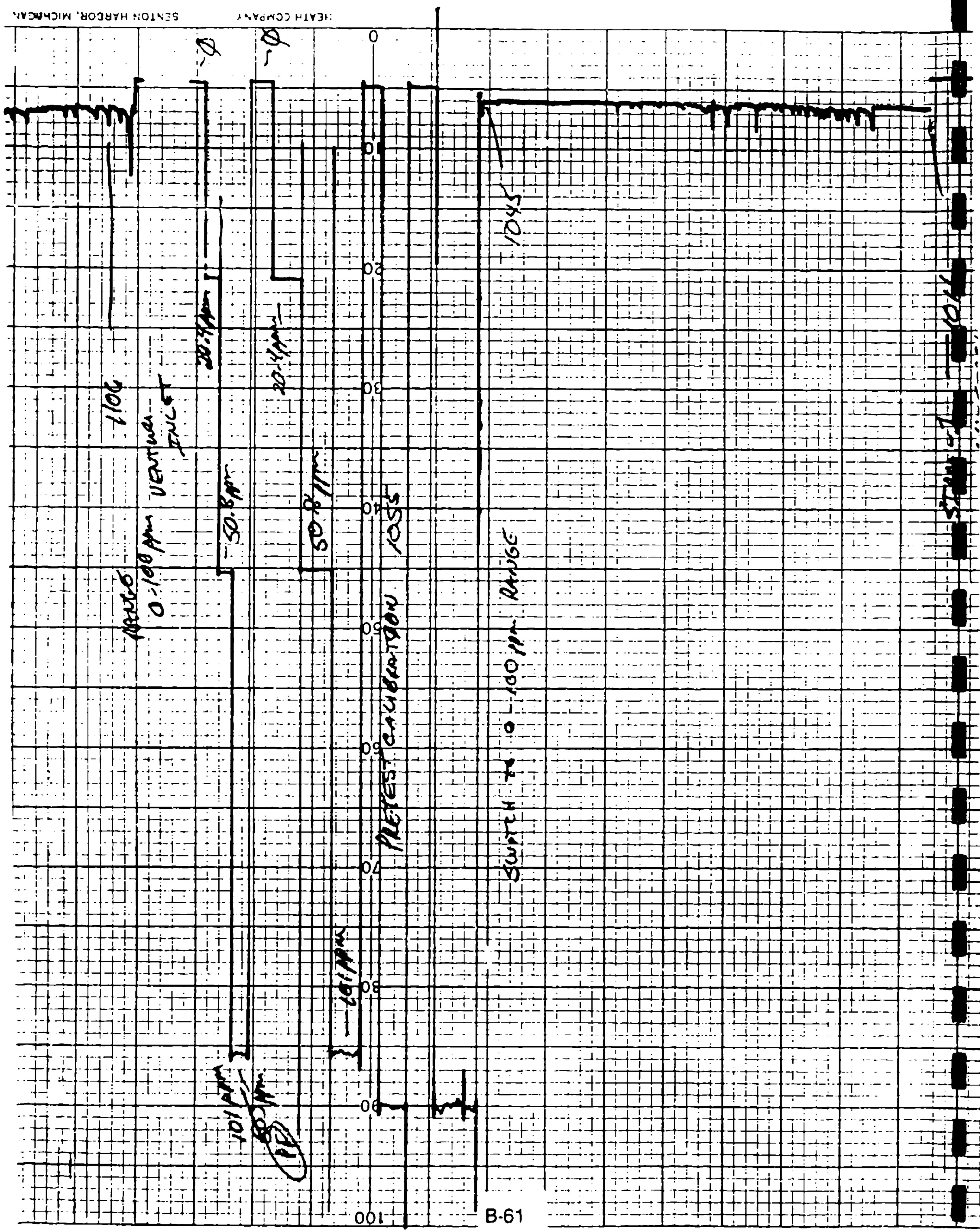
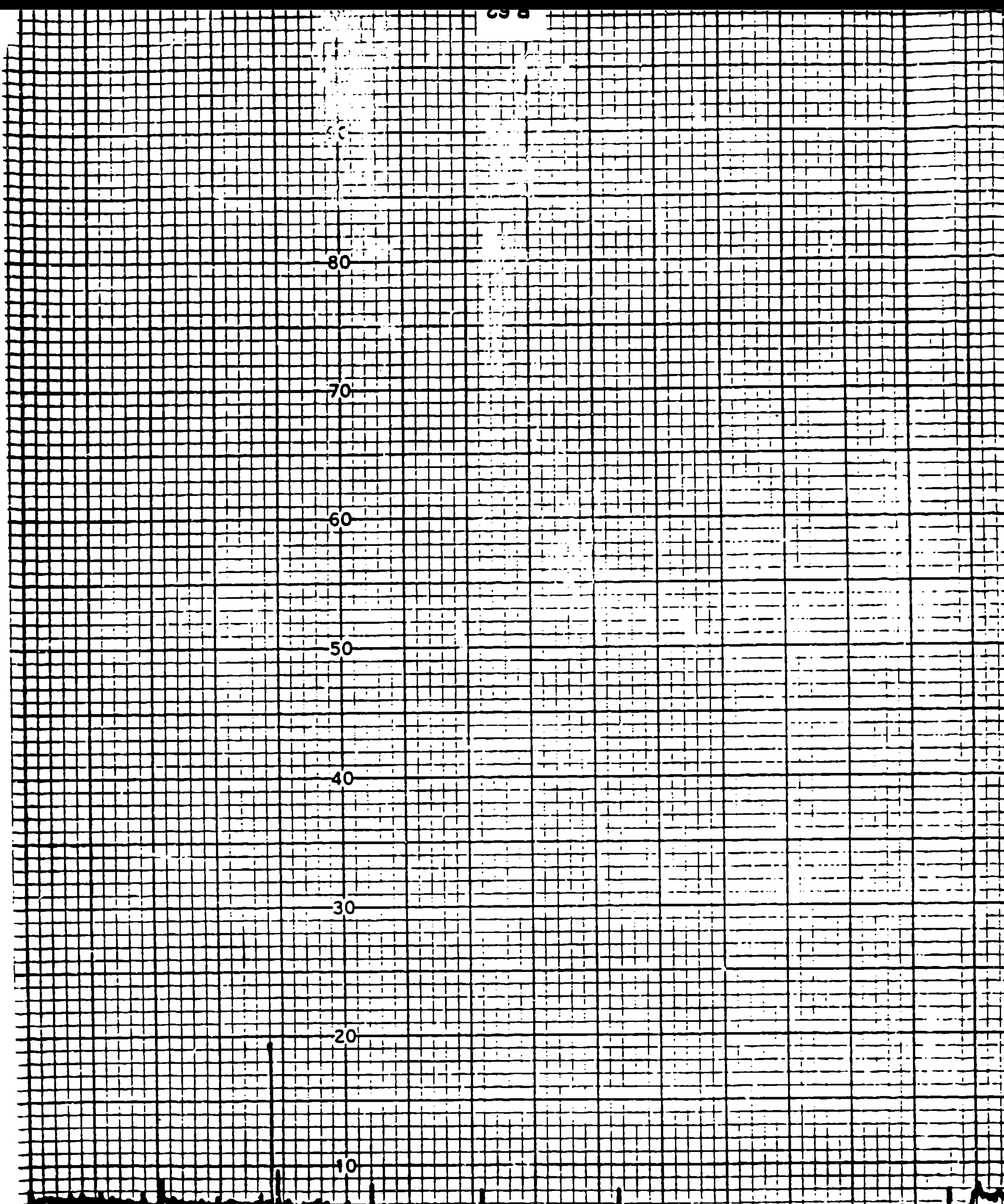
10
20
30
40
50
60
70
80
90
100
STEPM-1 — 1011
IN-STACK
VENTURI INLET
Ø
Ø
-101ppm
-300ppm
-503ppm
PRE-TEST CALIBRATIONS 0805
DAILY CAL
2-JUL-91 RED RIVER ARMY DEPOT
PILOT PYROLYSIS UNIT
PN: 805625
CH-5000 1CH/MIN


HEATH COMPANY
BENTON HARBOR, MICHIGAN
1106
0-100 ppm VENTURI INLET
20.4 ppm
50.8 ppm
101 ppm
20.4 ppm
50.8 ppm
101 ppm
PRETEST CALIBRATION
1055
1045
SWITCH to 0-100 ppm RANGE
100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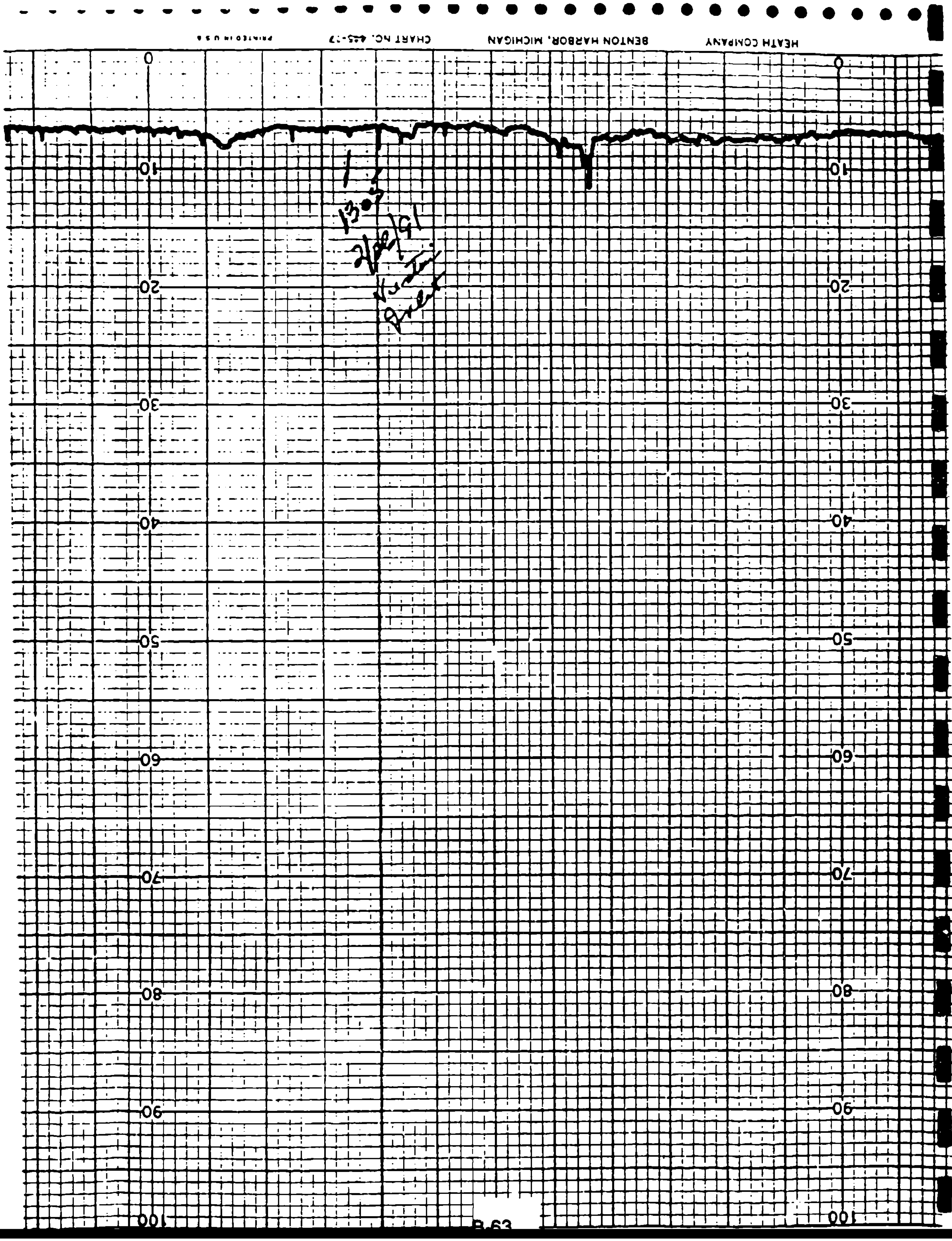
70
60
50
40
30
20
10
0
CHART NO. 445-17
PRINTED IN U.S.A.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BENTON HARBOR, MICHIGAN
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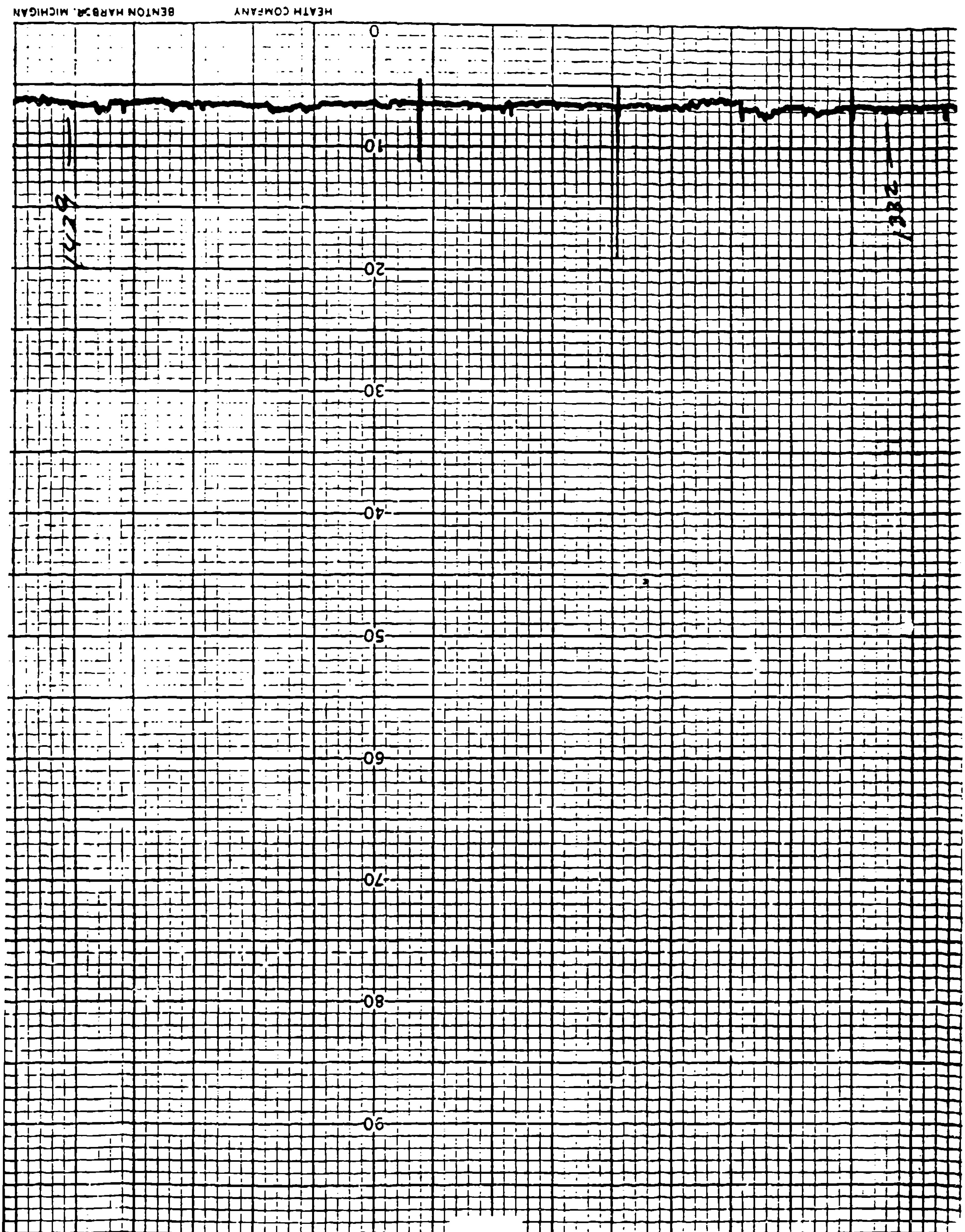


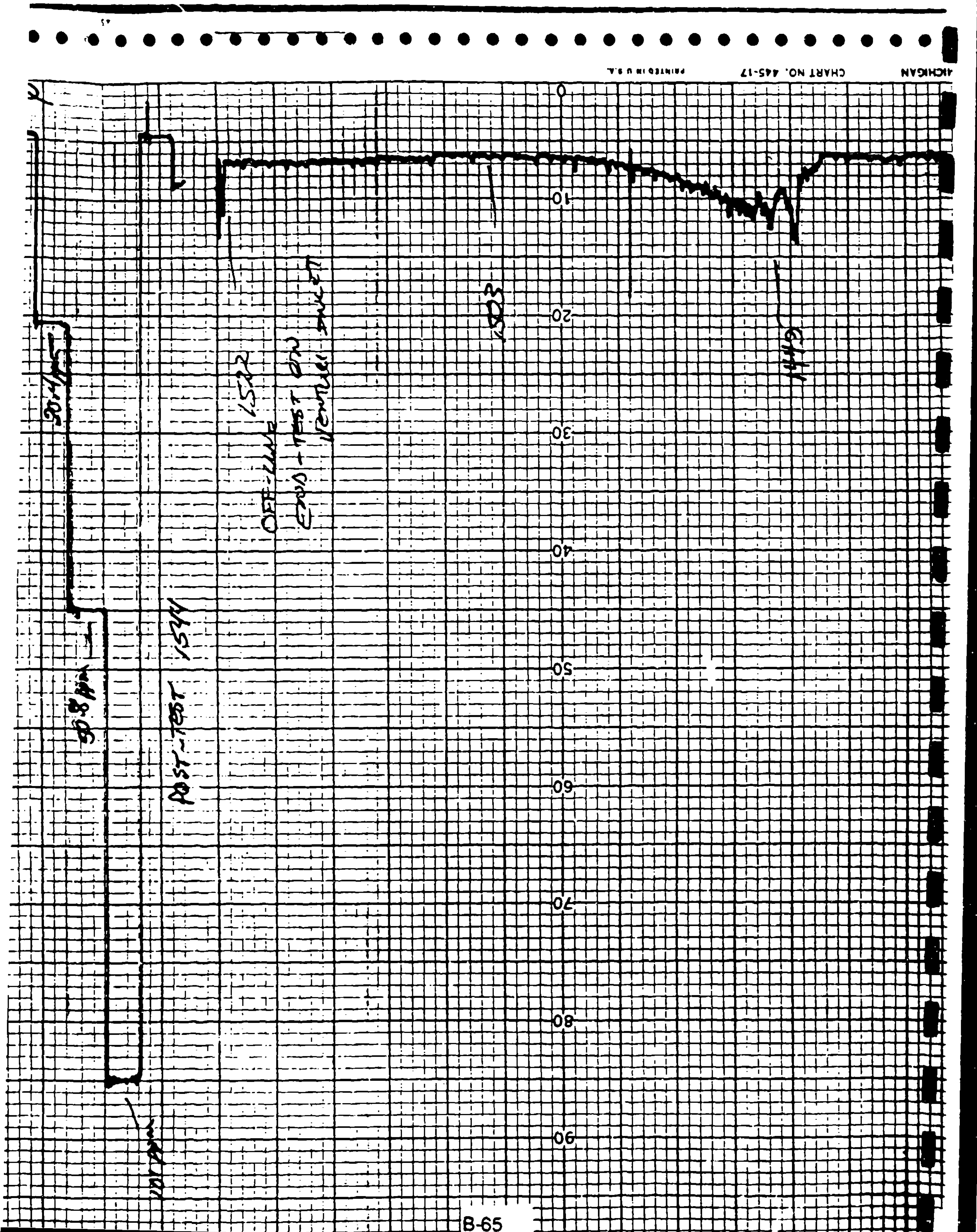


CHART NO. 445-17
PRINTED IN U.S.A.
0
10
20
30
40
50
60
70
80
90
POST-TEST 1544
OFF-LINE 1522
1503
1441

DAILY CEM CALIBRATION AND PERFORMANCE EVALUATION

Plant	RRAD	Parameter	SO_2, CO_2, O_2, NO_x, THC
Location	TEXARKANA	Monitor	BECKMAN 402
Date	2-27-91	Span value	ppm or % 561.2
Operator	P Fitzgerald	Chart scale	100
PN	805625	Pbar, in.Hg	29.97
Time, Pretest 0651 Post-test 1539		Tamb, °F	70°
Run No.	AFTERBURNER INLET		

Cylinder No.	Cal. gas conc., ppm or %	Chart divisions Pretest	Chart divisions Posttest	Concentration predicted by equation* Pretest	Concentration predicted by equation* Posttest	Analyzer calibration error,** % of span	Drift,*** % of span
ALMO05362	503	90.3	88.5	504.1	493.5	-.2	1.9
ALM009755	300	55.3	55.3	298.1	298.1	.3	0
ALM010010	101	21.8	22.8	100.9	106.8	.02	-1.1
AAL3491	0	4.8	6.3	.8	9.7	-.1	1.6

* Perform linear regression of pretest cal. gas concentration vs. chart divisions to determine following equation:

$y = mx + b$ x = ppm y = chart division

For data reduction:

$$\text{Pollutant ppm/\%} = \frac{(\text{Chart division} - b)}{m} = \frac{(CD - 4.66)}{(.1699)}$$

Correlation coef. = .9999

** Analyzer cal. error, % span = $\frac{(\text{Cal. gas conc.} - \text{conc. predicted}) \times 100}{\text{Span value}}$

Acceptable limit = ≤2% of span (±5% for THC).

*** Drift % span = $\frac{(\text{Posttest cal. response} - \text{initial cal. response}) \times 100}{\text{Span value}}$

Acceptable limit ≤3% of span

Minimum detectable limit = 2% of span or 11.2 ppm or % (circle one)

Maximum zero drift = 1.6 % of span or ______ ppm or % (circle one)

Maximum cal. drift = 1.9 % of span or ______ ppm or % (circle one)

COMMENTS: Pretest or posttest (circle one) calibration used to quantitate sample data. Posttest is used if drift exceeds limits and if posttest yields higher concentrations.

RR 3-28-91

CEM DATA REDUCTION SHEET FOR BAG ANALYSIS OR STEADY READINGS

Date 2-27-91 Parameter SO_2, NO_x*, CO_2, O_2, THC, CO

Operator [illegible] PN 815605 Location AFTERBURNER INLET

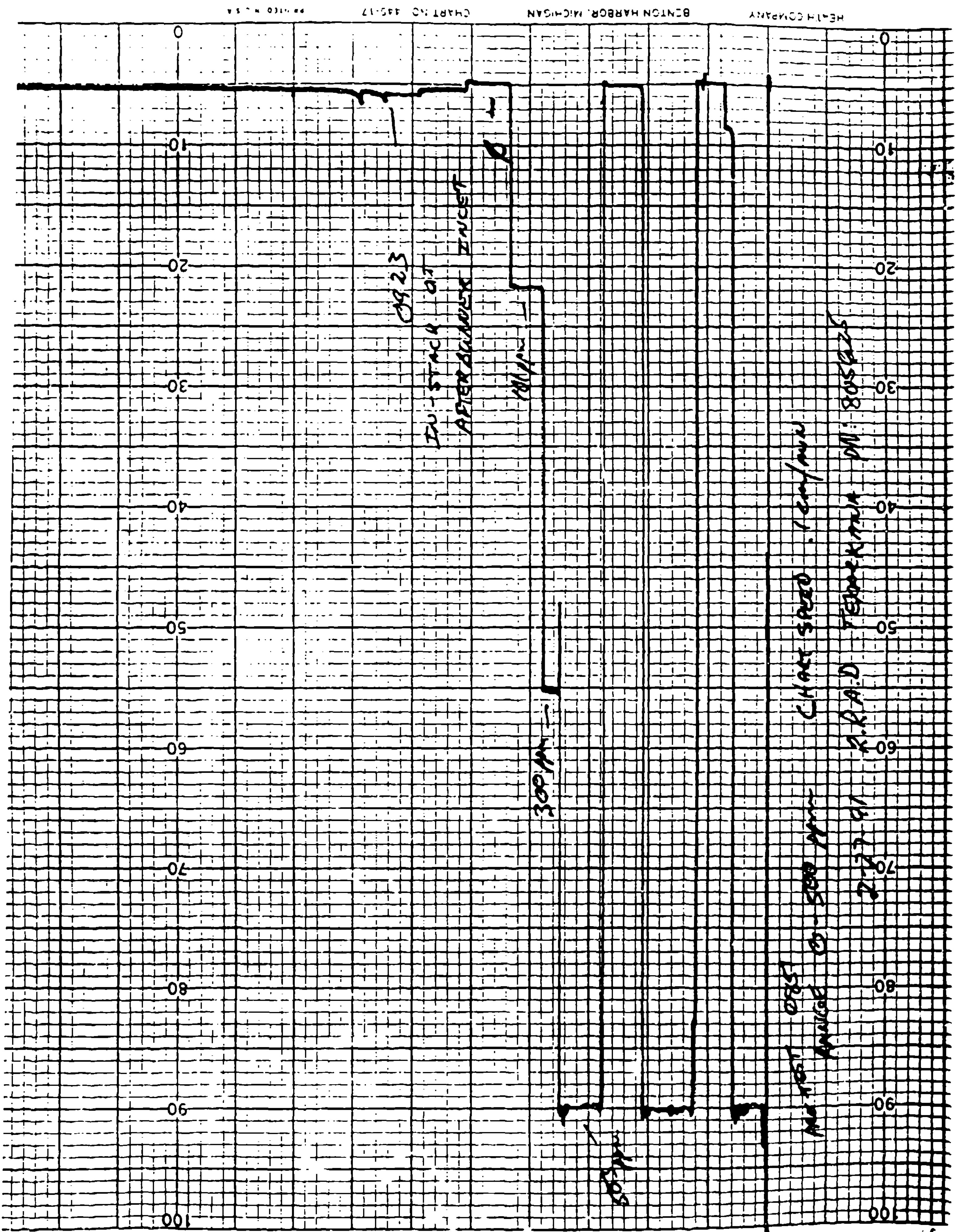
Pollutant ppm/% = $\frac{\text{(Chart division - b)}}{m}$ = $\frac{(CD - 4.66)}{(.1699)}$

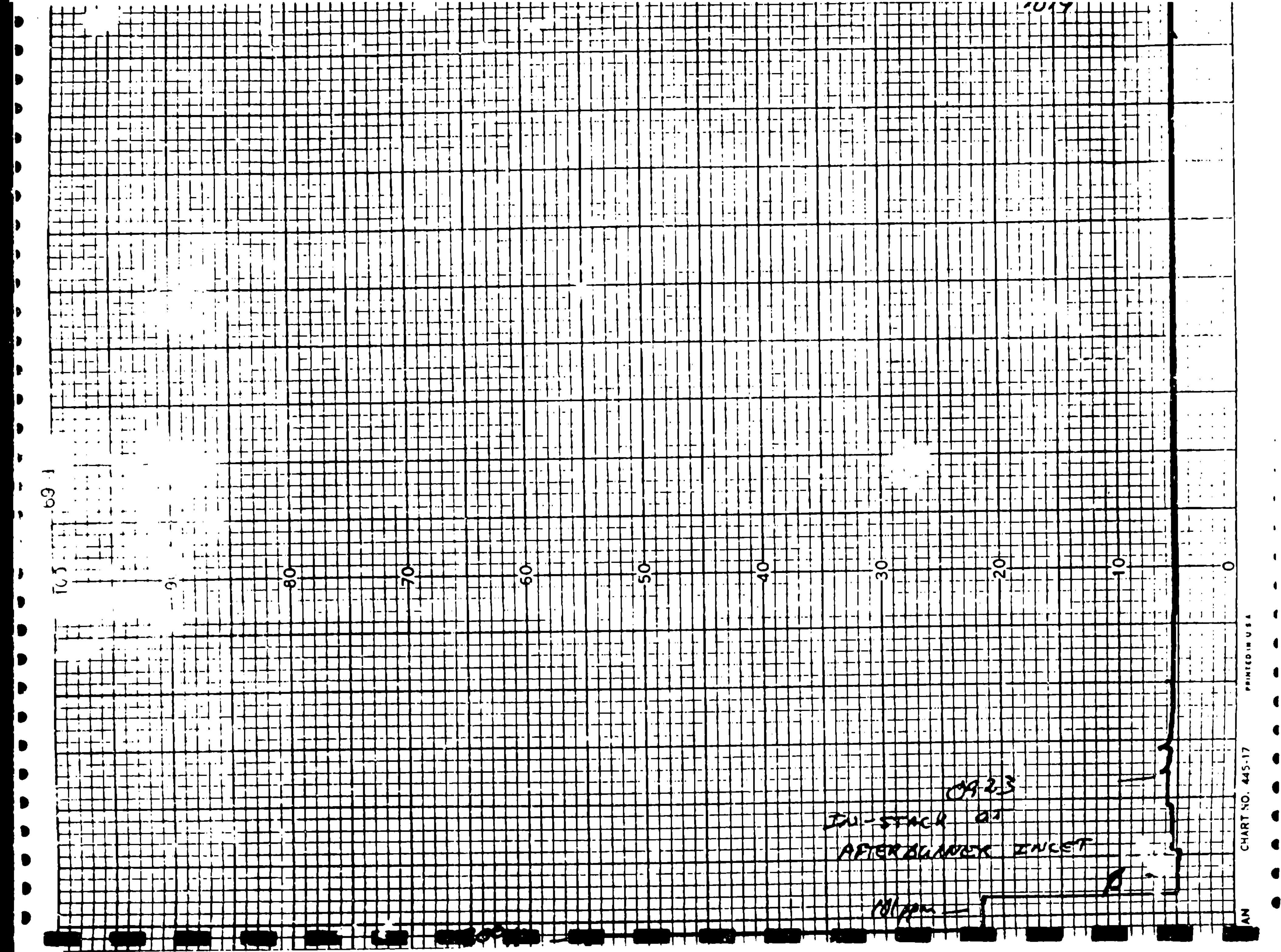
Run No.	Time** (24-H)	Average chart division	Conc.	Comments
AFTER BURNER INLET	1023-1039	5.3	3.5	at ~1040 offscale 100+ CD >560 ppm offscale @1040 - 1105 (~5000 ppm est) — UNDER MINIMUM DETECTABLE LIMIT.
	1039-1105			TIME APPROXIMATE — OVER UPPER LIMIT OR OFF-SCALE
	1105-1135	40.3	209.8	TIME APPROXIMATE @1105 Instrument "onscale" 1105 (~ 510 ppm) - 1135 (~ 61 ppm).
	1135-1143	13.8	53.8	
	1143-1145	10.0	31.4	TIMES APPROXIMATE
	1145-1255	~~12.2~~ 13	~~44.4~~ 49.1	VERY ERRATIC
	1255-1331	10.2	32.6	
	1331-1340	100+	750	STEADILY ROSE FROM 30 ppm TO OFF SCALE @ 500 ppm
	1340-1346	50	~2670	OFF SCALE - Range Multiplier 500 100 (x10)
	1346-1430	26.8	130.3	Gradually decreasing from 77 CD (410 ppm) to 13 CD (49 ppm) @ 1430.
	1430-1445	11.4	39.7	
	1445-1531	7.5	18.5	

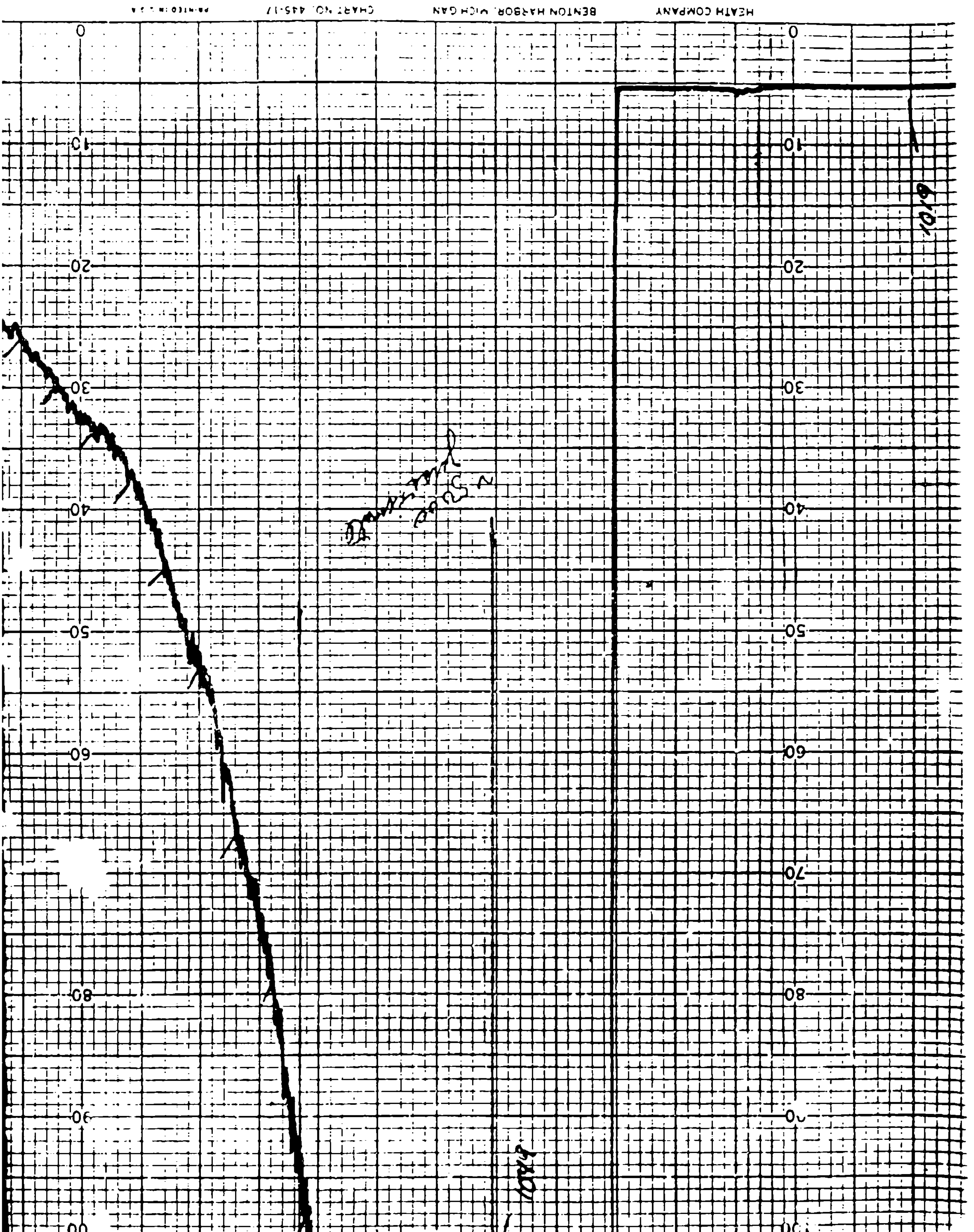
* For NO_x indicate whether NO, NO + NO_2, or NO_2 for specific interval.

** Indicate whether time interval is from beginning of first time to beginning of second time or to end of second time (circle one, or describe alternate).

Calculated by [illegible] on 3-8-91 Checked by D A Chaffin on 3-28-91


HEATH COMPANY
BENTON HARBOR, MICHIGAN
CHART NO. 445-17
IN-STACK
AFTERBURNER INLET
141 ppm
300 ppm
500 ppm
CHART SPEED 1 cm/min
ANALYZER 0-500 ppm


0
10
20
30
40
50
60
70
80
90
100
0923
IN-STACK O2
AFTERBURNER INLET
CHART NO. 445-17
PRINTED IN U.S.A.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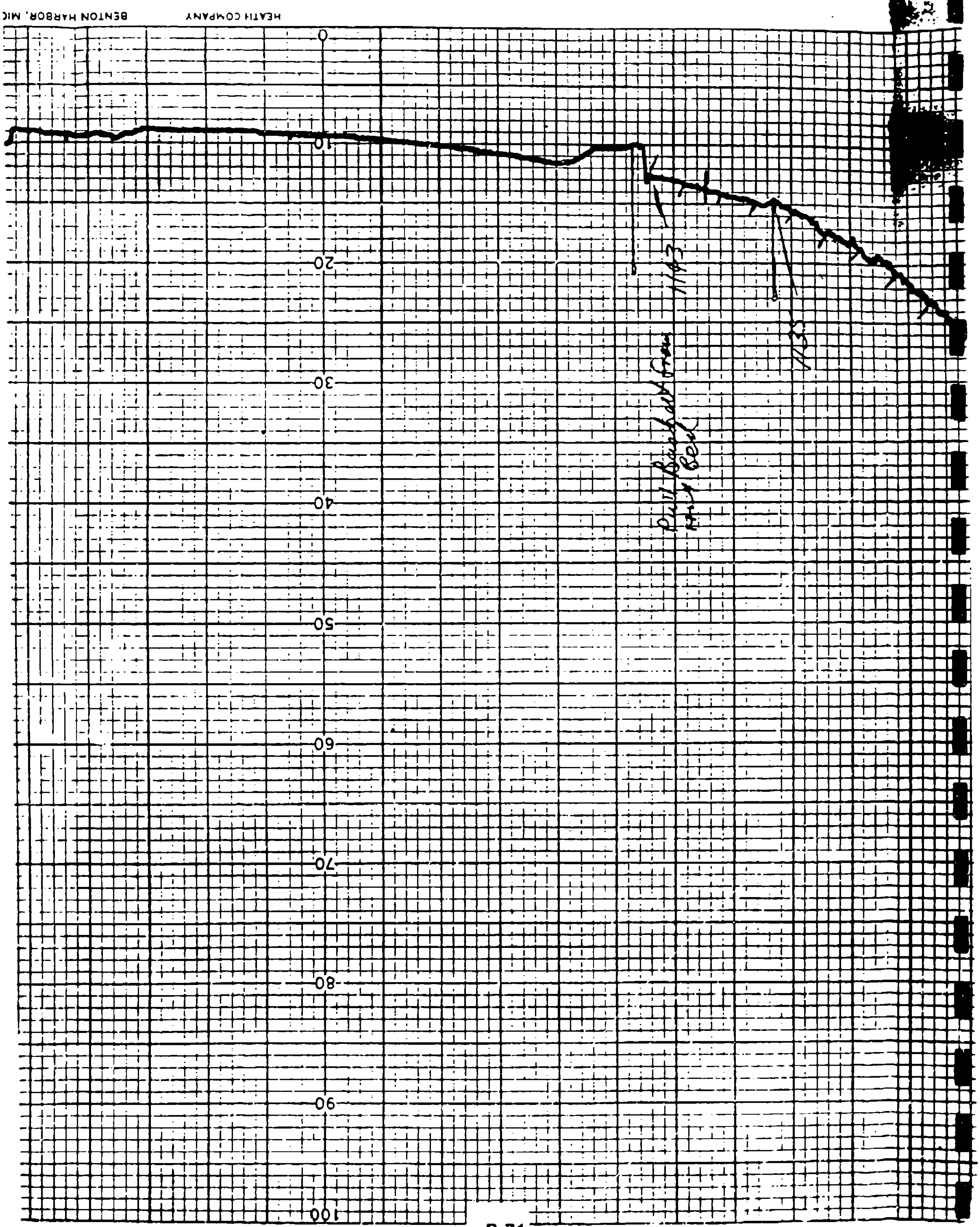
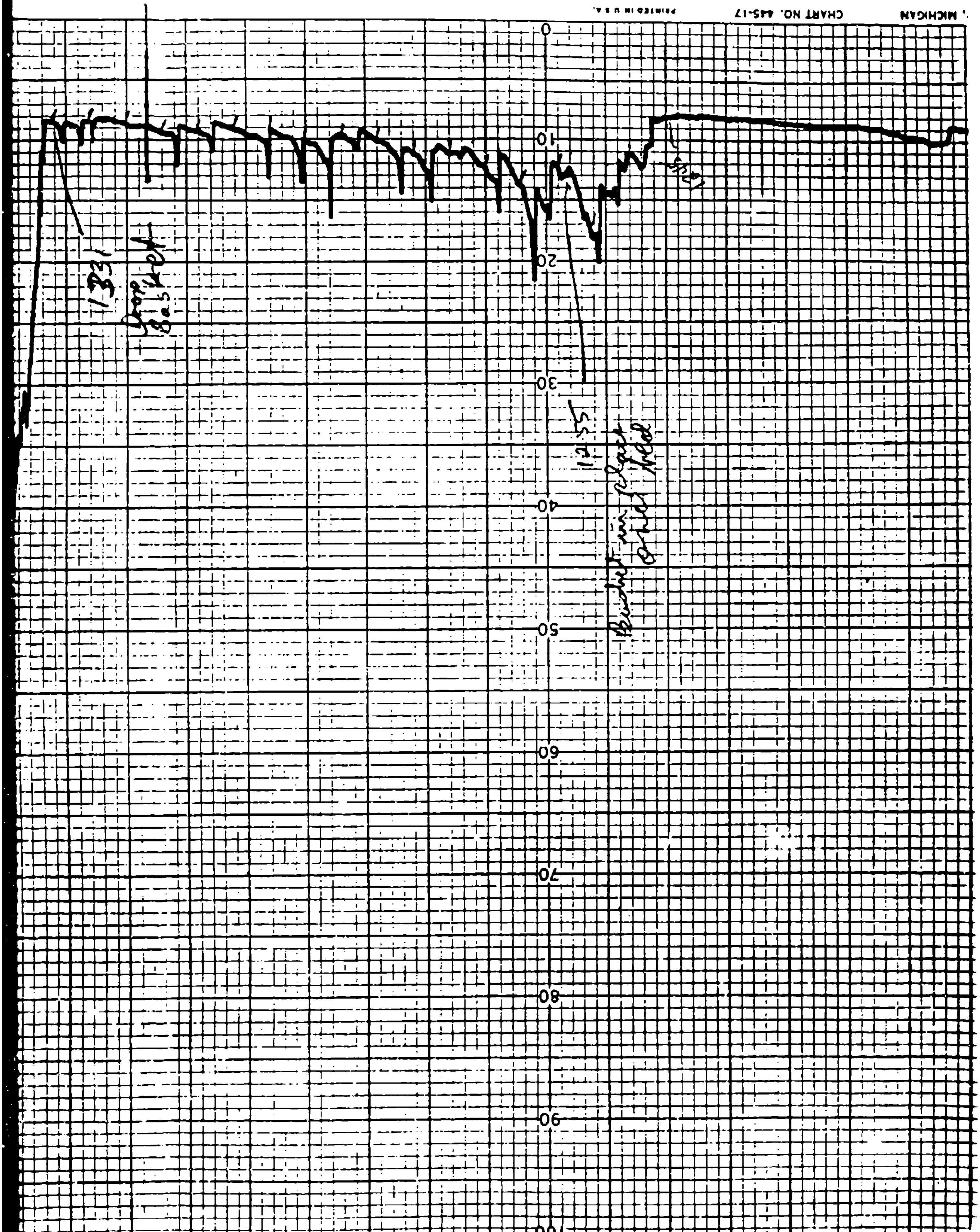
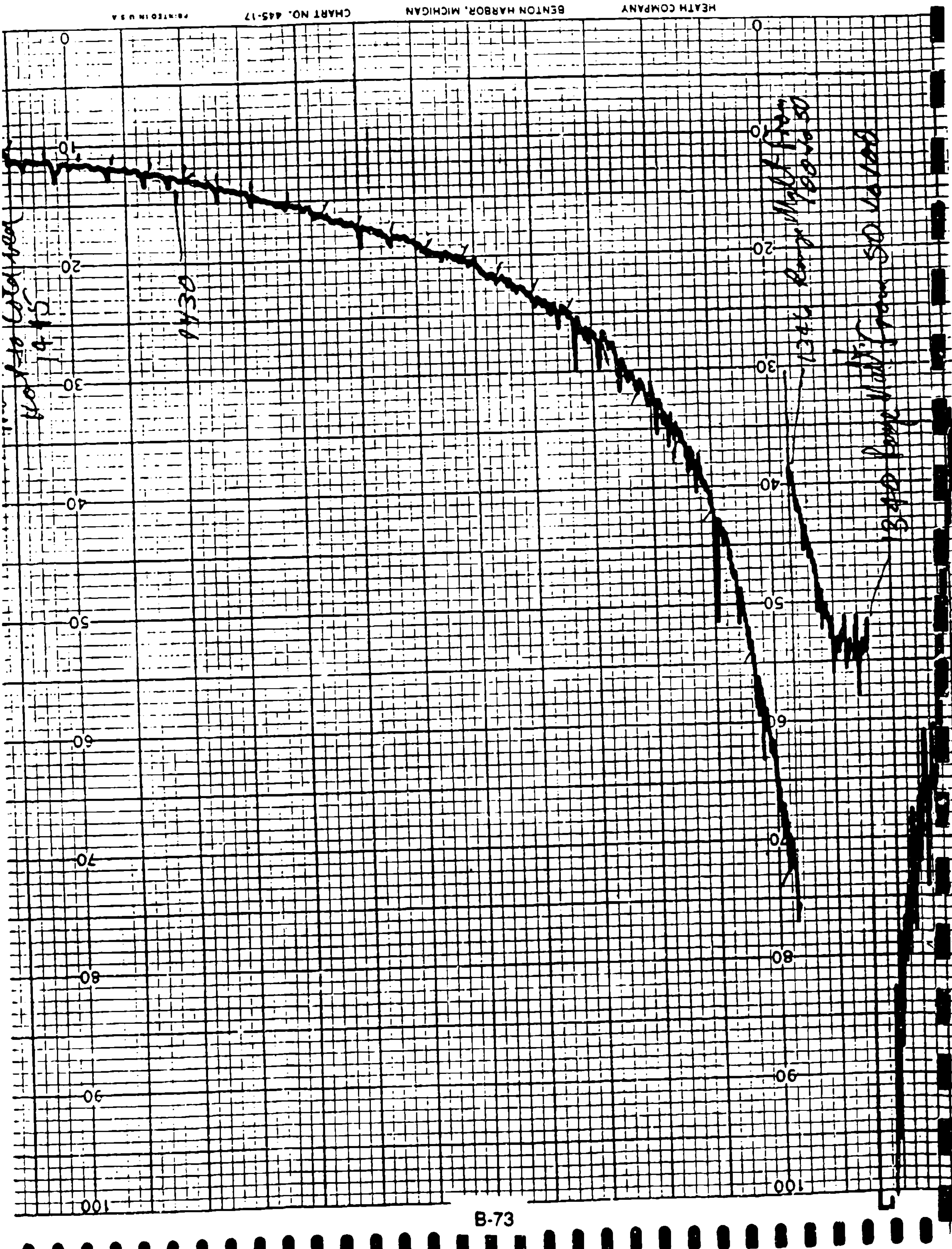
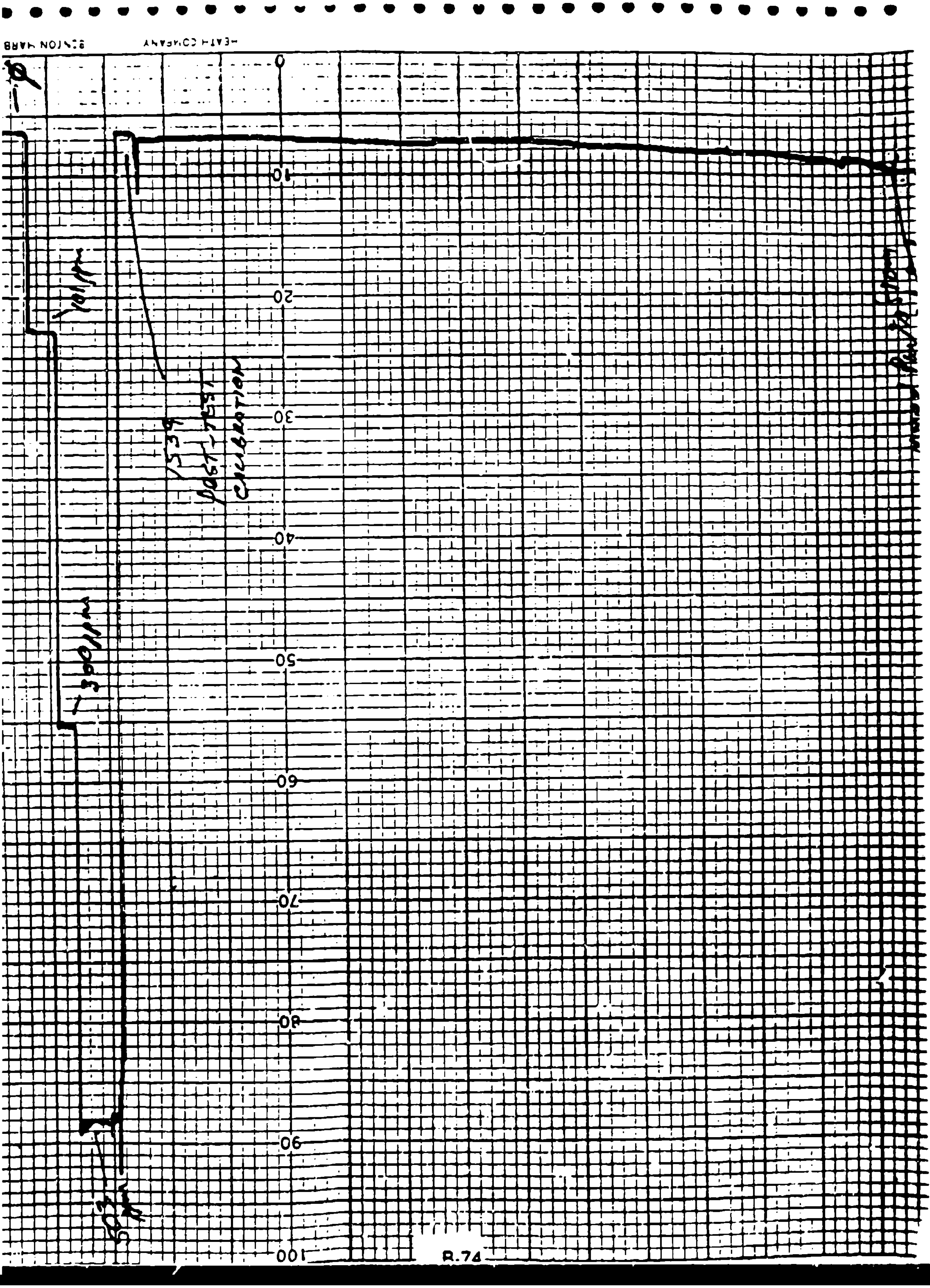
BENTON HARBOR, MICHIGAN
CHART NO. 445-17
B-70


HEATH COMPANY
BENTON HARBOR, MIC
0
10
20
30
40
50
60
70
80
90
100



MICHIGAN
CHART NO. 445-17
PRINTED IN U.S.A.
0
10
20
30
40
50
60
70
80
90
100
Drop Basket
12:55


HEATH COMPANY
BENTON HARBOR, MICHIGAN
CHART NO. 445-17
PRINTED IN U.S.A.
1430


0
10
20
30
40
50
60
70
80
90
100
1539
POST-TEST
CALIBRATION

DAILY CEM CALIBRATION AND PERFORMANCE EVALUATION

Plant	R.R.A.D.	Parameter	SO_2, CO_2, O_2, NO_x, THC
Location	Texarkana	Monitor	Beckman 402
Date	2-28-91	Span value ppm or %	548.7
Operator	P. Fitzgerald	Chart scale	100
PN	805625	Pbar, in.Hg	29.75
Time, Pretest 0759 Post-test 1330		Tamb, °F	70
Run No.	Afterburner Inlet		

Cylinder No.	Cal. gas conc., ppm or %	Chart divisions		Concentration predicted by equation*		Analyzer calibration error,** % of span	Drift,*** % of span
		Pretest	Posttest	Pretest	Posttest		
ALM005362	503	92.3	93.8	504.0	512.9	-.2	-1.6
ALM009755	300	57.0	58.5	298.6	307.3	.3	-1.6
ALM010010	101	23.0	24.8	100.8	111.3	.04	-1.9
AAL 3691	0	5.8	7.5	.8	10.6	-.1	-1.8

* Perform linear regression of pretest cal. gas concentration vs. chart divisions to determine following equation:

$y = mx + b \quad x = ppm \quad y = \text{chart division}$

For data reduction:

Pollutant ppm/% $= \frac{(\text{Chart division} - b)}{m} = \frac{(CD - 5.67)}{(.1719)}$

Correlation coef. = .9999

** Analyzer cal. error, % span $= \frac{(\text{Cal. gas conc.} - \text{conc. predicted}) \times 100}{\text{Span value}}$

Acceptable limit = ≤2% of span (±5% for THC).

*** Drift % span $= \frac{(\text{Posttest cal. response} - \text{initial cal. response}) \times 100}{\text{Span value}}$

Acceptable limit ≤3% of span

Minimum detectable limit = 2% of span or 11.0 ppm or % (circle one)

Maximum zero drift = -1.8 % of span or ______ ppm or % (circle one)

Maximum cal. drift = -1.9 % of span or ______ ppm or % (circle one)

COMMENTS: Pretest or posttest (circle one) calibration used to quantitate sample data. Posttest is used if drift exceeds limits and if posttest yields higher concentrations.

DL 3-28-91

CEM DATA REDUCTION SHEET FOR BAG ANALYSIS OR STEADY READINGS

Date 2-28-91 Parameter SO_2, NO_x,* CO_2, O_2, THC, CO

Operator AF PN 805625 Location AFTERBURNER INLET

Pollutant ppm/% = $\frac{\text{(Chart division - b)}}{\text{m}}$ = $\frac{(CD - 5.67)}{(.1719)}$

Run No.	Time** (24-H)	Average chart division	Conc.	Comments
~~[illegible]~~ AFTER BURNER INLET	0805-0831	n/a	n/a	OFF SCALE > 2600 ppm
	0831-0905	18.0	71.7	26 CD (118 ppm) → 14 CD (48.9 ppm)
	0905-0920	12.6	40.3	
	0920-0932	10.8	29.8	
	0932-1005	9.0	19.4	
	1005-1041	7.8	12.4	
	1041-1138	7.5	10.6	BELOW MINIMUM DETECTABLE LIMIT
	1138-1157	NA	NA	OFF SCALE > 2600 ppm
	1157-1253	20.1	83.9	56 CD (293 ppm) → 12 CD (37 ppm)

* For NO_x indicate whether NO, NO + NO_2, or NO_2 for specific interval.

** Indicate whether time interval is from beginning of first time to beginning of second time or to end of second time (circle one, or describe alternate).

Calculated by [signature] on 3-8-91 Checked by [signature] on 3-28-91

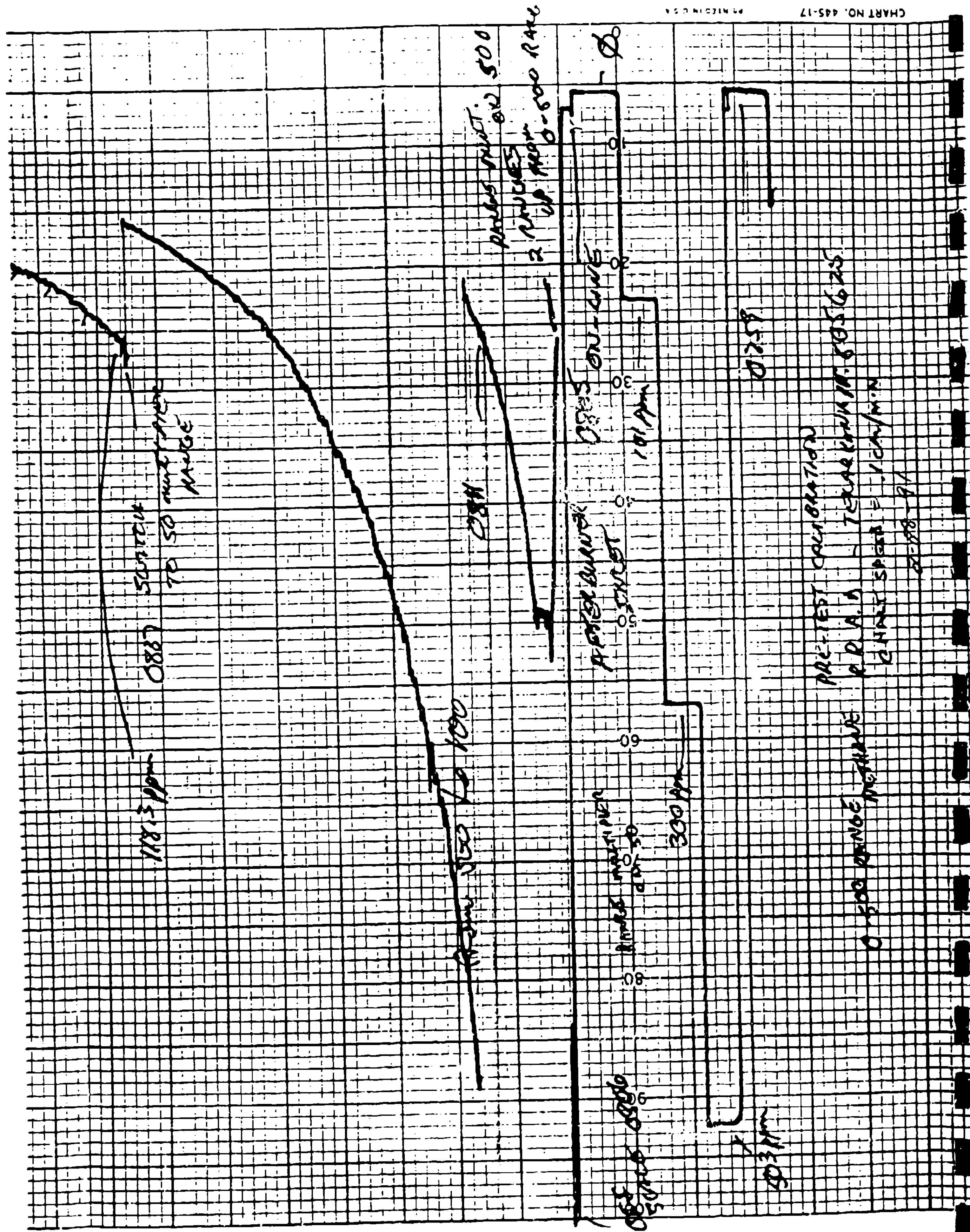
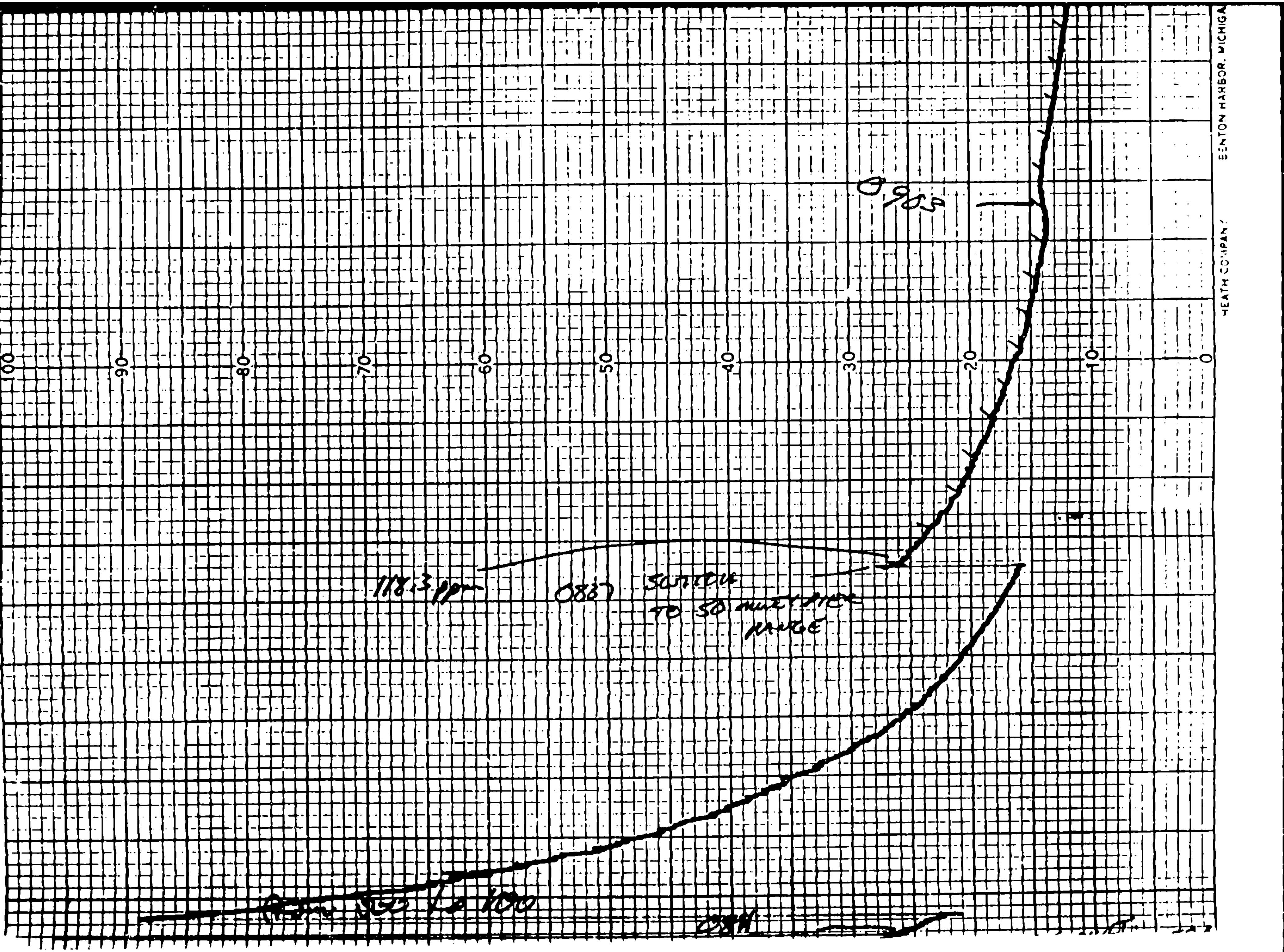


CHART NO. 445-17
PRE-TEST CALIBRATION


HEATH COMPANY
BENTON HARBOR, MICHIGAN
0
10
20
30
40
50
60
70
80
90
100
0905
118.3 ppm
0887
SWITCH
TO 50 MULTIPLIER
RANGE

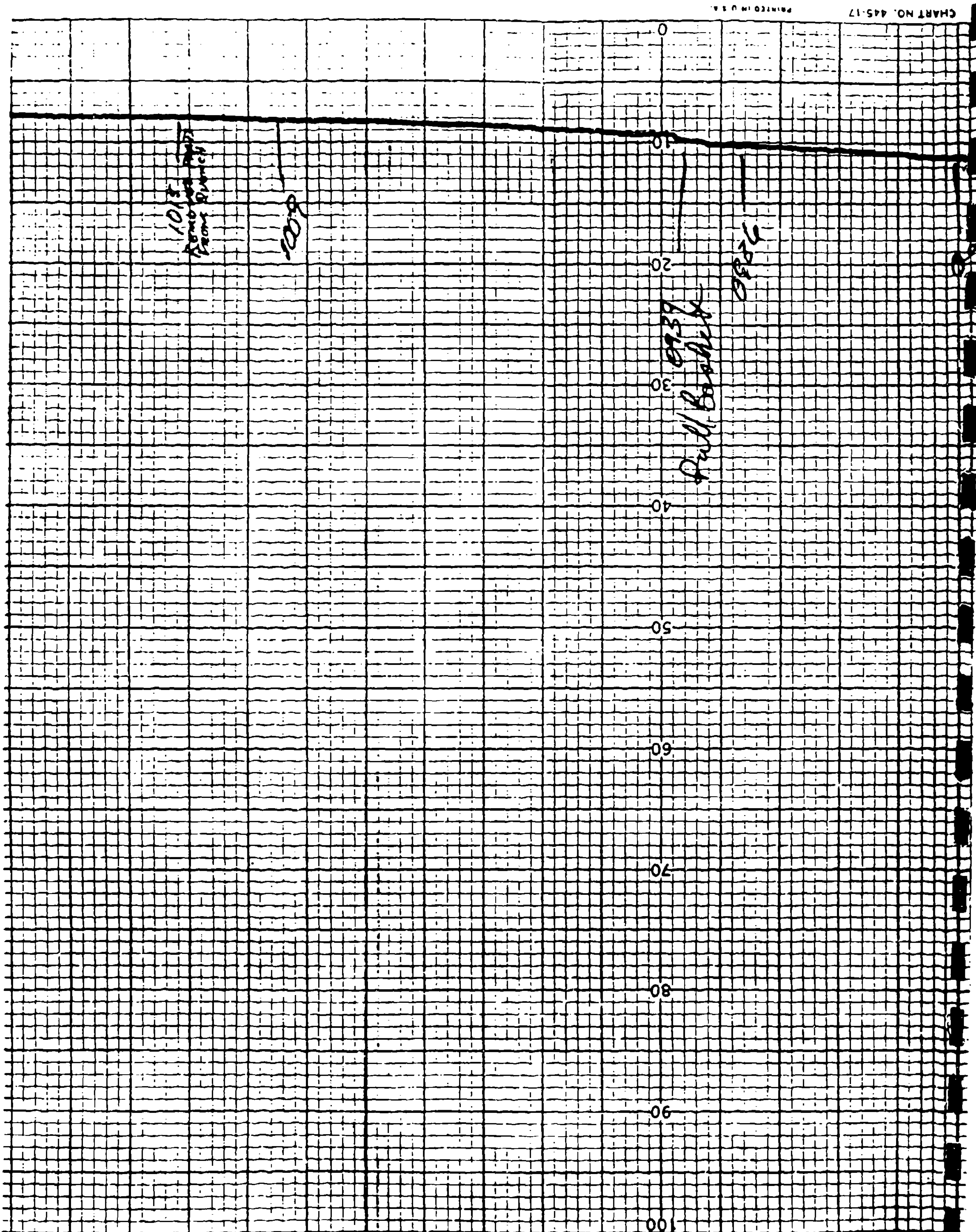
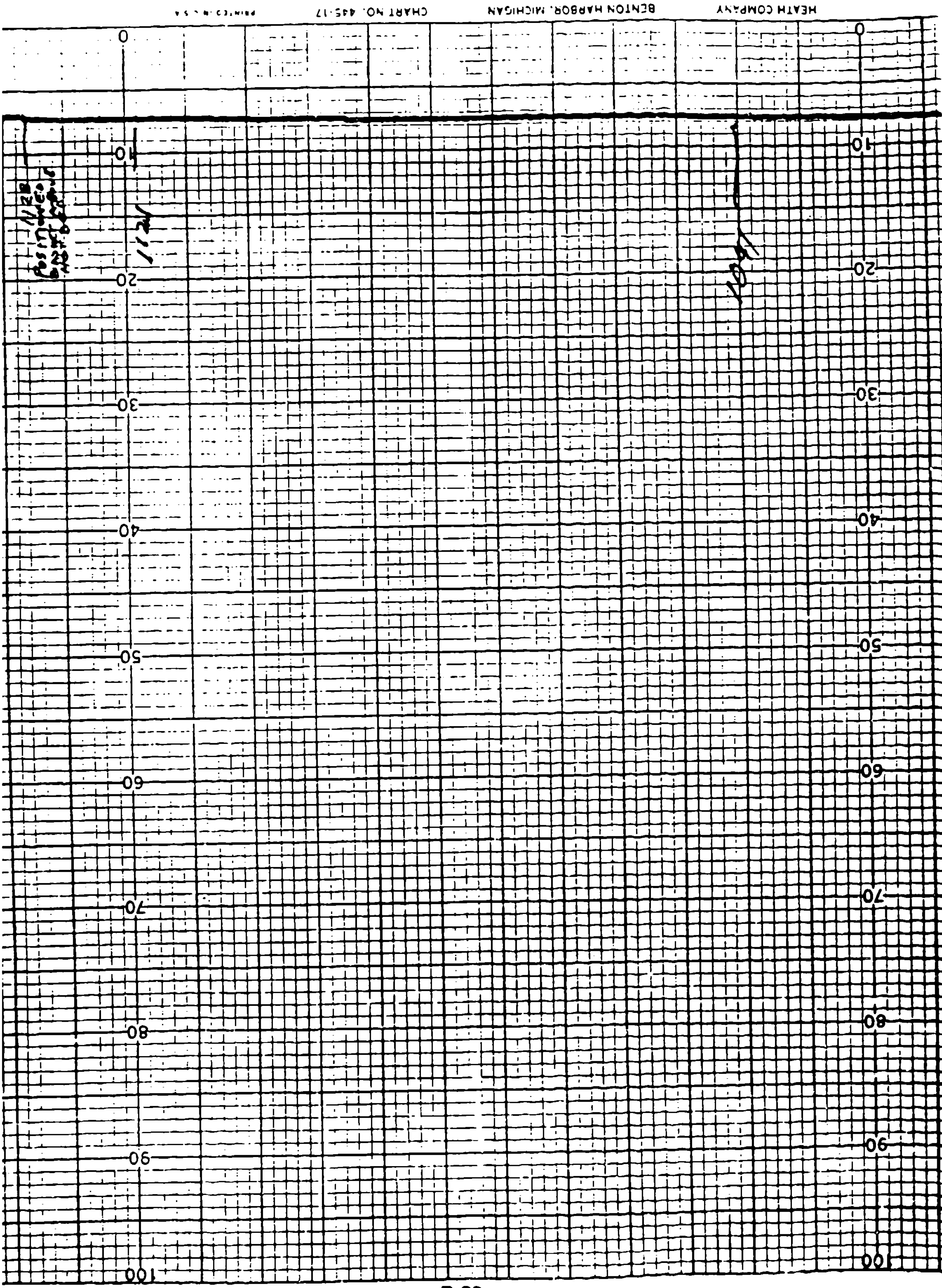
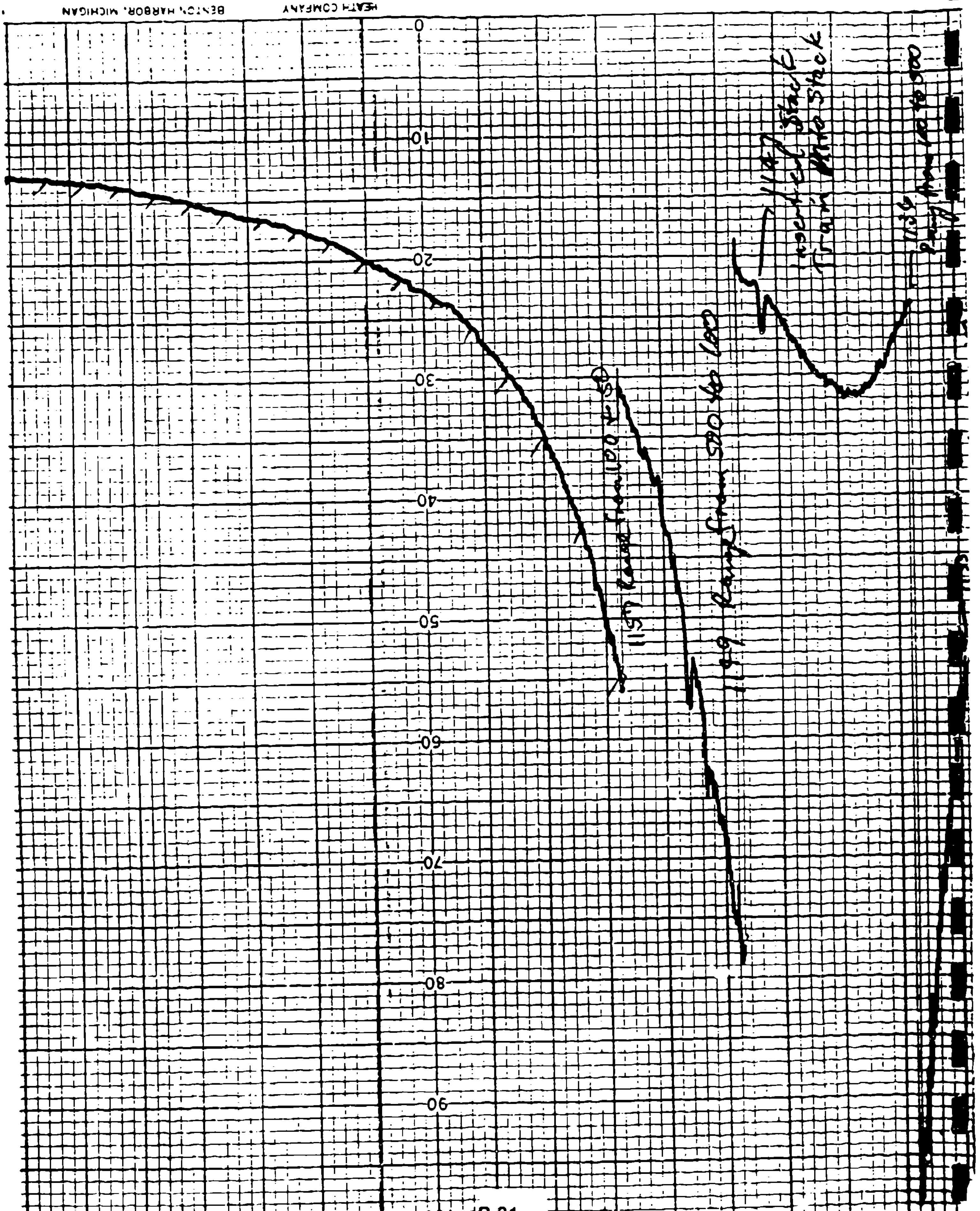


CHART NO. 445-17
PRINTED IN U.S.A.
0
10
20
30
40
50
60
70
80
90
100
1013 Removed Pump from Ditch
1009
0937 Pull Boat Back
0926


HEATH COMPANY
BENTON HARBOR, MICHIGAN
CHART NO. 445-17


HEATH COMPANY
BENTON HARBOR, MICHIGAN
0
10
20
30
40
50
60
70
80
90
100

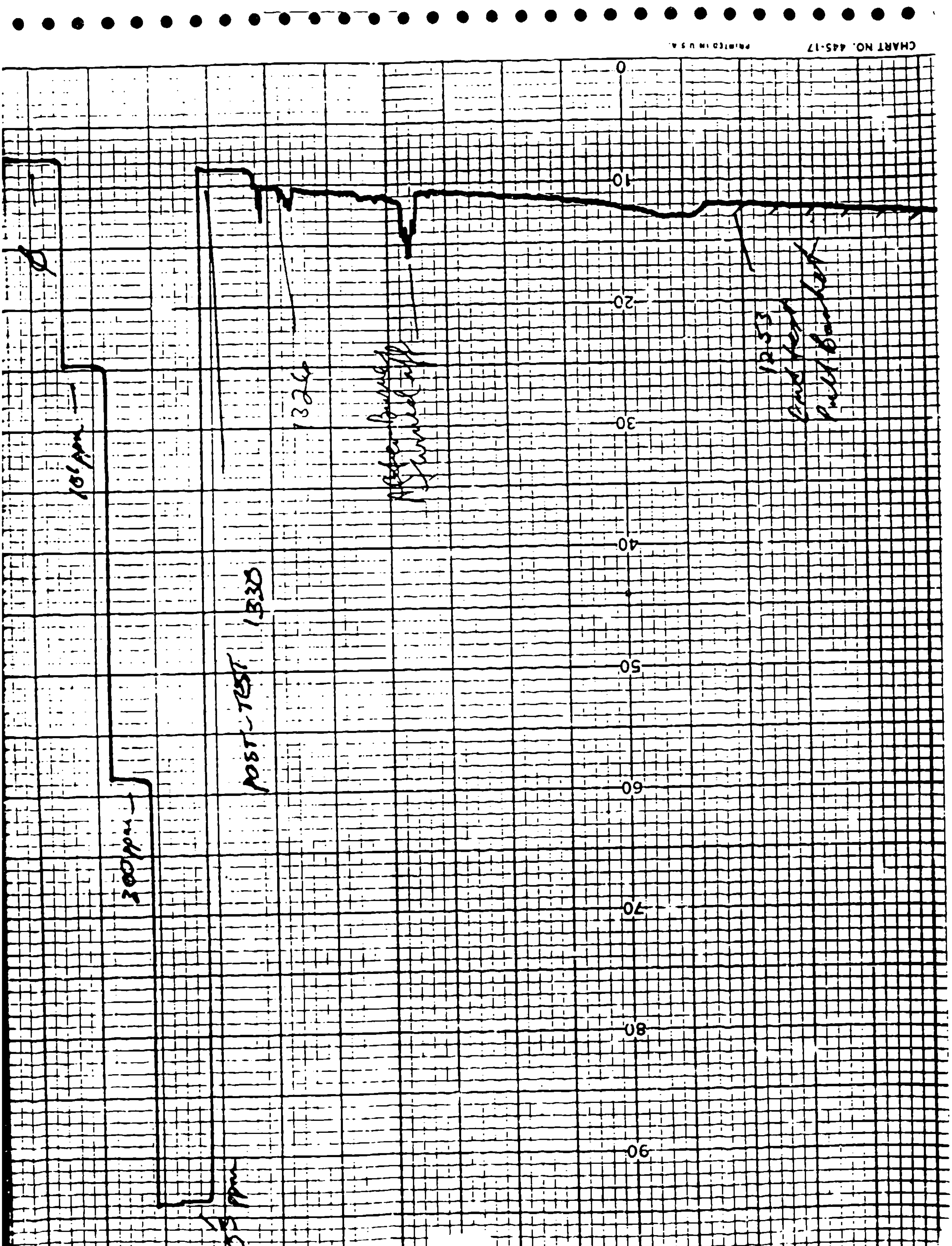


CHART NO. 445-17
PRINTED IN U.S.A.
0
10
20
30
40
50
60
70
80
90
100
101 ppm
200 ppm
505 ppm
POST-TEST 1330
1326
1253

APPENDIX C

LABORATORY DATA SHEETS

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

ITAQS Cincinnati — Date: April 9, 1991

Attn: Mr. Chuck Bruffey

Job Number 21341 — P.O. Number 805625

This is the Certificate of Analysis for the following samples:

Client Project ID:	USATHAMA Project
Date Received:	March 5, 1991
Work Order:	X1-03-031
Number of Samples:	11
Sample Type:	Sand/Water

I. Introduction

Six sand and five water samples arrived at ITAS Cincinnati on March 5, 1991. The samples were sent for analytical work in support of monitoring work on the USATHAMA Project. The samples are labeled as follows:

Sand # 1 (1)	Sand # 5 (1)	Water # 31 (1)
Sand # 2 (1)	Sand # 6	Water # 32 (1)
Sand # 3 (1)	Water # 30	Water # 33 (1)
Sand # 4		Water # 34

(1) These samples were placed on hold per client's request.

II. Analytical Results/Methodology

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information, the analytical results, and the appropriate detection limits.

The analyses requested are listed on the following page.

Reviewed and Approved by:

Tom Peter for TS

Tim Soward
Project Manager
103031

II. Analytical Results/Methodology (cont.)

* Lead by Graphite Furnace Atomic Absorption; EPA Method 7421

* Cadmium, Chromium and Zinc by Inductively Coupled Plasma Spectroscopy; EPA Method 6010

III. Quality Control

Immediately following the analytical data for the samples can be found the QA/QC information that pertains to these samples. The purpose of this information is to demonstrate that the data enclosed is scientifically valid and defensible. This QA/QC data is used to assess the laboratory's performance during the analysis of the samples it accompanies. All quantitations were performed from within the calibrated range of the analytical instrument.

Client: USATHAMA
Work Order: X1-03-031
10303103

IT ANALYTICAL SERVICES
CINCINNATI, OH

Analytical Results, mg/L

Client Sample ID	Water # 30	Water # 34	
Lab No.	07	11	
Analyte			Detection Limit
Cadmium	0.004	0.007	0.002
Chromium	0.083	0.064	0.006
Lead	ND	ND	0.02
Zinc	0.082	0.20	0.008

ND = Not detected above the reported detection limit

Quality Control
Standard Reference Solutions

Analyte	Theoretical Value	Percent Recovery
Cadmium	1	95.3, 95.7
Chromium	1	99.2, 100
Lead	0.075	93.9
Zinc	1	97.1, 102

Client: USATHAMA
Work Order: X1-03-031
10303102

IT ANALYTICAL SERVICES
CINCINNATI, OH

Analytical Results, ug/g

Client Sample ID	Sand # 4	Sand # 6	
Lab No.	04	06	Detection Limit
Analyte			
Cadmium	26.7	40.4	0.2
Chromium	14.3	35.1	0.3
Lead	25.9 (1)	77.5	2
Zinc	38.4	161	0.5

ND = Not detected above the reported detection limit

(1) The detection limit for lead for this sample is 0.3 ug/g

Quality Control
Standard Reference Solutions

Analyte	Theoretical Value	Percent Recovery
Cadmium	1	96.3, 97.0
Chromium	1	99.4, 99.0
Lead	0.075	92.9, 90.1
Zinc	1	94.8, 96.0

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

ITAQS Cincinnati   Date: April 19, 1991

Attn: Mr. Chuck Bruffey

Job Number 21341   P.O. Number 805625

This is the Certificate of Analysis for the following samples:

Client Project ID:	USATHAMA Project
Date Received:	March 5, 1991
Work Order:	X1-04-026
Number of Samples:	4
Sample Type:	Sand

I. Introduction

Four sand samples arrived at ITAS Cincinnati on March 5, 1991. The samples were sent for analytical work in support of monitoring work on the USATHAMA Project. The samples are labeled as follows:

Sand # 1	Sand # 3
Sand # 2	Sand # 5

(1) These samples were taken off hold for additional analysis on April 1, 1991.

II. Analytical Results/Methodology

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information, the analytical results, and the appropriate detection limits.

The analyses requested are listed on the following page.

Reviewed and Approved by:

Timothy Soward

Timothy Soward
Project Manager
104026

American Council of Independent Laboratories
International Association of Environmental Testing Laboratories
American Association for Laboratory Accreditation

IT Analytical Services • 11499 Chester Road • Cincinnati, OH 45246 • 513-782-4600

II. Analytical Results/Methodology (cont.)

* Lead by Graphite Furnace Atomic Absorption; EPA Method 7421

* Cadmium, Chromium and Zinc by Inductively Coupled Plasma Spectroscopy; EPA Method 6010

III. Quality Control

Immediately following the analytical data for the samples can be found the QA/QC information that pertains to these samples. The purpose of this information is to demonstrate that the data enclosed is scientifically valid and defensible. This QA/QC data is used to assess the laboratory's performance during the analysis of the samples it accompanies. All quantitations were performed from within the calibrated range of the analytical instrument.

Client: USATHAMA
Work Order: X1-04-026
10402602

IT ANALYTICAL SERVICES
CINCINNATI, OH

Analytical Results, ug/g

Client Sample ID	Lab No.	Cadmium	Chromium	Lead	Zinc
Sand # 1	01	ND	9.8	0.70	2.9
Sand # 2	02	1.7	13	18	16
Sand # 3	03	5.5	24	23	34
Sand # 5	04	2.8	15	23	22
Detection Limit		0.2	0.3	0.4	0.5

Quality Control
Standard Reference Solutions

Analyte	Theoretical Value	Percent Recovery
Cadmium	1	98.4
Chromium	1	102
Lead	0.075	105, 105
Zinc	1	97.5

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

ITAQS Cincinnati — Date: April 9, 1991

Attn: Mr. Chuck Bruffey

Job Number 21341 — P.O. Number 805625

This is the Certificate of Analysis for the following samples:

Client Project ID:	USATHAMA Project
Date Received:	March 5, 1991
Work Order:	X1-03-046
Number of Samples:	8
Sample Type:	Multi-Metals Trains

I. Introduction

Eight multi-metals trains arrived at ITAS Cincinnati on March 5, 1991. The samples were sent for analytical work in support of monitoring work on the USATHAMA Project. The samples are labeled as follows:

Run # AIPM-1	Run # AIPM-5
Run # AIPM-2	Run # AIPM-6
Run # AIPM-3	Run # AIPM-7
Run # AIPM-4	Run # AIPM-8

II. Analytical Results/Methodology

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information, the analytical results, and the appropriate detection limits.

Each train consisted of a filter, acetone, and HNO3 impinger. The filter and acetone were analyzed per EPA 5. After EPA 5 analysis they were composited with the HNO3 impinger and analyzed for the metals listed on the next page.

Reviewed and Approved by:

Lani Rotell for TS

Tim Soward
Project Manager
103046

IT Analytical Services • 11499 Chester Road • Cincinnati, OH 45246 • 513-782-4600

II. Analytical Results/Methodology (cont.)

* Lead by Graphite Furnace Atomic Absorption; EPA Method 7421

* Cadmium, Chromium and Zinc by Inductively Coupled Plasma Spectroscopy; EPA Method 6010

III. Quality Control

Immediately following the analytical data for the samples can be found the QA/QC information that pertains to these samples. The purpose of this information is to demonstrate that the data enclosed is scientifically valid and defensible. This QA/QC data is used to assess the laboratory's performance during the analysis of the samples it accompanies. All quantitations were performed from within the calibrated range of the analytical instrument.

The lead analyses by Atomic Absorption were done in duplicate. The average is reported.

Client: USATHAMA
Work Order: X1-03-046
10304602

IT ANALYTICAL SERVICES
CINCINNATI, OH

Analytical Results, ug

Client Sample ID	Run # AIPM-1	Run # AIPM-2	Run # AIPM-3	
Lab No.	01	02	03	
Analyte				Detection Limit
Cadmium	160	63	7.7	2
Chromium	190	250	11	3
Lead	540	160	49	11
Zinc	1300	490	86	5

Client Sample ID	Run # AIPM-4	Run # AIPM-5	Run # AIPM-6	
Lab No.	04	05	06	
Analyte				Detection Limit
Cadmium	12	40	61	2
Chromium	37	130	75	3
Lead	64	160	190	11
Zinc	78	660	270	5

Client Sample ID	Run # AIPM-7	Run # AIPM-8	
Lab No.	07	08	
Analyte			Detection Limit
Cadmium	160	44	2
Chromium	85	19	3
Lead	290	110	11
Zinc	670	140	5

ND = Not detected above the reported detection limit

Client: USATHAMA
Work Order: X1-03-046
10304603

IT ANALYTICAL SERVICES
CINCINNATI, OH

Quality Assurance Data

Quality Control
Standard Reference Solutions

Analyte	Theoretical Value, mg/L	Percent Recovery
Cadmium	1	86.7, 95.8
Chromium	1	85.6, 87.8
Lead	0.75	92.0, 84.4
Zinc	1	80.4, 82.9

Method 5 Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant:HAAP TENNESSEE — Run No.:A1PM-1

Sample Location:AFTERBURNER/INLET — Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g — Lab #:X10304601B

Acetone Volume: [illegible] ml

Date & Time of Wt.	3/15/91 [illegible]:45AM	Beaker Gross Wt.:	101419.4 mg
Date & Time of Wt.	3/14/91 8:10AM	Beaker Gross Wt.:	101418.9 mg
		Average Gross Wt.:	101419.2 mg
		Beaker Tare Wt.:	101218.7 mg
		Less acetone blank wt.:	1.4 mg
		Particulate Wt.:	199.1 mg

Filter # [illegible] — Lab #:X10304601A

Date & Time of Wt.	3/14/91 8:10AM	Filter Gross Wt.:	569.3 mg
Date & Time of Wt.	3/14/91 4:30PM	Filter Gross Wt.:	569.4 mg
		Average Gross Wt.:	569.4 mg
		Filter Tare Wt.:	439.6 mg
		Weight of Particulate on Filter:	129.8 mg
		Weight of Particulate in Acetone Rinse:	199.1 mg
		Total Wt. of Particulate:	328.9 mg

Signature of Analyst: Melissa A. Ellerson — Date: 3-19-91

Signature of Reviewer: Ken Mueller — Date: 4/1/91

Meth[illegible] Analytical Particulate Data
[illegible] Rinses and Filter(s)

Plant: RRAD-TEXARKANA Run No.: AIPM-2

Sample Location AFTERBURNER/INLET Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone [illegible] Residue Conc. 0.0077 mg/g Lab #: X10304602B

Acetone Volume: 1[illegible] ml

Date & Time of Wt. 3/1[illegible]/91 6:40AM Beaker Gross Wt.: 102803.3 mg

Date & Time of Wt. 3/14/91 [illegible]:10AM Beaker Gross Wt.: 102802.9 mg

Average Gross Wt.: 102803.1 mg

Beaker Tare Wt.: 102702.5 mg

less acetone blank wt.: 0.9 mg

Particulate Wt.: 99.7 mg

Filter # [illegible] Lab #: X10304602A

Date & Time of Wt. [illegible]/14/91 [illegible]AM Filter Gross Wt.: 486.3 mg

Date & Time of Wt. 3/14/91 4:30PM **Filter Gross Wt.: 486.2 mg**

Average Gross Wt.: 486.3 mg

Filter Tare Wt.: 467.3 mg

Weight of Particulate on Filter: **19.0 mg**

Weight of Particulate in Acetone Rinse: **99.7 mg**

Total Wt. of Particulate: **118.7 mg**

Signature of Analyst: Melissa A. Elgasso Date: 3-19-91

Signature of Reviewer: Ken Mueller Date: 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant:RRAD-TEXARKANA Run No.:AIPM-3

Sample Location AFTERBURNER/INLET Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.00[illegible] mg/g Lab #:X103046038

Acetone Volume: [illegible] ml

Date & Time of Wt.[illegible] [illegible]:45AM Beaker Gross Wt.: 97684.7 mg

Date & Time of Wt.3/14/91 [illegible]:10AM Beaker Gross Wt.: 97684.[illegible] mg

Average Gross Wt.: 97684.5 mg

Beaker Tare Wt.: 97669.6 mg

Less acetone blank wt.: 0.8 mg

Particulate Wt.: 14.1 mg

Filter # [illegible] Lab #:X103046038A

Date & Time of Wt.[illegible] 91 [illegible]:10AM Filter Gross Wt.: 426.5 mg

Date & Time of Wt.3/14/91 4:30PM Filter Gross Wt.: 426.5 mg

Average Gross Wt.: 426.5 mg

Filter Tare Wt.: 420.6 mg

Weight of Particulate on Filter: 5.9 mg

Weight of Particulate in Acetone Rinse: 14.1 mg

Total Wt. of Particulate: 20.0 mg

Signature of Analyst: Melissa A. Ellersor Date: 3-19-91

Signature of Reviewer: Ken Mueller Date: 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant: KRAD-TEXARKANA   Run No.: AIPM-4

Sample Location AFTERBURNER/INLET   Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g   Lab #: X10304604B

Acetone [illegible] 11[illegible] ml

Date & Time of Wt. 3/14/91 8:10AM   Beaker Gross Wt.: 106002.5 mg

Date & Time of Wt. 3/14/91 4:00PM   Beaker Gross Wt.: 106002.3 mg

Average Gross Wt.: 106002.4 mg

Beaker Tare Wt.: 105961.7 mg

less acetone blank wt.: 0.7 mg

Particulate Wt.: 40.0 mg

Filter # [illegible]   Lab #: X10304604A

Date & Time of Wt. 3/14/91 8:30AM   Filter Gross Wt.: 437.0 mg

Date & Time of Wt. 3/14/91 4:30PM   Filter Gross Wt.: 436.8 mg

Average Gross Wt.: 436.9 mg

Filter Tare Wt.: 421.4 mg

Weight of Particulate on Filter: 15.5 mg

Weight of Particulate in Acetone Rinse: 40.0 mg

Total Wt. of Particulate: 55.5 mg

Signature of Analyst: Melissa A. Ellersson   Date: 3-19-91

Signature of Reviewer: Ken Mueller   Date: 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant: RRAD-TEXARKANA Run No.: AIPM-5

Sample Location AFTERBURNER/INLET Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g Lab #: X10304605B

Acetone Volume: 95 ml.

Date & Time of Wt. 3/13/91 6:45AM Beaker Gross Wt.: 102176.8 mg

Date & Time of Wt. 3/14/91 6:10AM Beaker Gross Wt.: 102176.3 mg

Average Gross Wt.: 102176.6 mg

Beaker Tare Wt.: 102101.6 mg

Less acetone blank wt.: 0.6 mg

Particulate Wt.: 74.4 mg

Filter # 901041 Lab #: X10304605A

Date & Time of Wt. 3/14/91 6:10AM Filter Gross Wt.: 359.7 mg

Date & Time of Wt. 3/14/91 4:30PM Filter Gross Wt.: 359.9 mg

Average Gross Wt.: 359.8 mg

Filter Tare Wt.: 331.0 mg

Weight of Particulate on Filter: 28.8 mg

Weight of Particulate in Acetone Rinse: 74.4 mg

Total Wt. of Particulate: 103.2 mg

Signature of Analyst: Melissa A. Ellerson Date: 3-19-91

Signature of Reviewer: Ken Mueller Date: 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant: RRAD-TEXARKANA Run No.: AIPM-6

Sample Location AFTERBURNER/INLET Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g Lab #: X10304606B

Acetone Volume: 14[illegible]

Date & Time of Wt. [illegible] [illegible]AM Beaker Gross Wt.: 104457.1 mg

Date & Time of Wt. 3/14/91 8:10AM Beaker Gross Wt.: 104456.6 mg

Average Gross Wt.: 104456.9 mg

Beaker Tare Wt.: 104415.7 mg

Less acetone blank wt.: 0.9 mg

Particulate Wt.: 40.3 mg

Filter # [illegible] Lab #: X10304606A

Date & Time of Wt. 3/14/91 8:10AM Filter Gross Wt.: 405.8 mg

Date & Time of Wt. 3/14/91 4:30PM Filter Gross Wt.: 405.9 mg

Average Gross Wt.: 405.9 mg

Filter Tare Wt.: 333.3 mg

Weight of Particulate on Filter: 72.6 mg

Weight of Particulate in Acetone Rinse: 40.3 mg

Total Wt. of Particulate: 112.9 mg

Signature of Analyst: Melissa A. Ellerson Date: 3-19-91

Signature of Reviewer: Ken Mueller Date: 4/1/91

Method [illegible] Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant:RRAD-TEXARKANA Run No.:AIPM-7

Sample LocationAFTERBURNER/INLET Density of Acetone 0.7899 g/ml ✓

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g ✓ Lab #:X10304607B

Acetone Volume: 200 ml ✓

Date & Time of Wt.3/13/91 8:45AM Beaker Gross Wt.:105917.6 mg ✓

Date & Time of Wt.3/14/91 8:10AM Beaker Gross Wt.:105917.5 mg ✓

Average Gross Wt.:105917.6 mg

Beaker Tare Wt.:105886.2 mg ✓

Less acetone blank wt.: 1.2 mg

Particulate Wt.: 30.2 mg

Filter # [illegible] Lab #:X10304607A

Date & Time of Wt.[illegible] Filter Gross Wt.: 355.6 mg ✓

Date & Time of Wt.3/14/91 4:30PM Filter Gross Wt.: 355.8 mg ✓

Average Gross Wt.: 355.7 mg

Filter Tare Wt.: 329.9 mg ✓

Weight of Particulate on Filter: 25.8 mg

Weight of Particulate in Acetone Rinse: 30.2 mg

Total Wt. of Particulate: 56.0 mg

Signature of Analyst: Melissa A. Ellason Date: 3-19-91

Signature of Reviewer: Ken Mueller Date: ~~3~~ 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant: RHAI-TEXARKANA   Run No.: AIPM-8

Sample Location AFTERBURNER/INLET   Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g   Lab #: X10304608B

Acetone Volume: 115 ml

Date & Time of Wt. 3/13/91 8:45AM   Beaker Gross Wt.: 101966.9 mg

Date & Time of Wt. 3/14/91 8:10AM   Beaker Gross Wt.: 101966.9 mg

Average Gross Wt.: 101966.9 mg

Beaker Tare Wt.: 101941.2 mg

Less acetone blank wt.: 0.7 mg

Particulate Wt.: 25.0 mg

Filter # 910683   Lab #: X10304608A

Date & Time of Wt. 3/14/91 8:10AM   Filter Gross Wt.: 342.8 mg

Date & Time of Wt. 3/14/91 4:30AM   Filter Gross Wt.: 342.9 mg

Average Gross Wt.: 342.9 mg

Filter Tare Wt.: 331.5 mg

Weight of Particulate on Filter: 11.4 mg

Weight of Particulate in Acetone Rinse: 25.0 mg

Total Wt. of Particulate: 36.4 mg

Signature of Analyst: Melissa A. Ellerson   Date: 3-19-91

Signature of Reviewer: Ken Mueller   Date: 4/1/91

INTERNATIONAL TECHNOLOGY CORPORATION

Laboratory Data

ITAS Cincinnati

Client: ITAQS UBATHA	Analysis: EPA 5
PN: Date: 3-11-91	Method Number: 07-015-00
Extracted By: M Ellessor	Checker: KMM 4/1/91

Run#	Cont#	Lab#	Tare	Vol	3-13-91 3:45 Am Gross	3-14-91 8:10 Am Gross	3-14-91 4:00 pm Gross	
AIPM-1	12207A	X1-03-046-01B	101.2127	228	101.4194	101.4189	464.	
AIPM-2	11080A	02B	102.7025	143	102.8033	102.8029		
AIPM-3	11030A	03B	97.6696	125	97.6847	97.6843		
AIPM-4	11125A	04B	105.9617	119	~~105.~~ 106.0034	106.0025	106.0023	
AIPM-5	11133A	05B	102.1016	95	102.1768	102.1763		
AIPM-6	11137A	06B	104.4157	145	104.4571	104.4566		
AIPM-7	11139A	07B	105.8862	200	105.9176	105.9175		
AIPM-8	11145A	08B	101.9412	119	101.9668	101.9667		
					3-13-91 11:30 AM	3-14-91 8:10 Am	3-14-91 4:30 pm	
Run#	Cont#	Lab#	Filter#	Tare	Gross	Gross	Gross	
AIPM-1	12208B	X1-03-046-01A	9070071	.4396 ✓	.5707	.5693	.5694	
AIPM-2	11080B	02A	9070092	.4673 ✓	.4874	.4863	.4862	
AIPM-3	11030B	03A	9070052	.4206 ✓	.4271	.4265	.4265	
AIPM-4	11125B	04A	9070055	.4214 ✓	.4388	.4370	.4368	
AIPM-5	11133B	05A	9010412	.3310 ✓	.3604	.3597	.3599	
AIPM-6	11137B	06A	9010427	.3333 ✓	.4067	.4058	.4059	
AIPM-7	1113B	07A	9010531	.3299 ✓	.3566	.3556	.3558	
AIPM-8	11145B	08A	~~9010~~ 9010532	.3315 ✓	.3428	.3429		

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

ITAQS Cincinnati

Date: April 9, 1991

Attn: Mr. Chuck Bruffey

Job Number 21341

P.O. Number 805625

This is the Certificate of Analysis for the following samples:

Client Project ID:	USATHAMA Project
Date Received:	March 5, 1991
Work Order:	X1-03-053
Number of Samples:	5
Sample Type:	Multi-Metals Trains

I. Introduction

Five multi-metals trains arrived at ITAS Cincinnati on March 5, 1991. The samples were sent for analytical work in support of monitoring work on the USATHAMA Project. The samples are labeled as follows:

Run # SIPM-1
Run # SIPM-2
Run # SIPM-3
Run # SIPM-4
Run # SIPM-5

II. Analytical Results/Methodology

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information, the analytical results, and the appropriate detection limits.

Each train consisted of a filter, acetone, and HNO3 impinger. The filter and acetone were analyzed per EPA 5. After EPA 5 analysis they were composited with the HNO3 impinger and analyzed for the metals listed on the next page.

Reviewed and Approved by:

Tim Soward
Project Manager
103053

II. Analytical Results/Methodology (cont.)

* Lead by Graphite Furnace Atomic Absorption; EPA Method 7421

* Cadmium, Chromium and Zinc by Inductively Coupled Plasma Spectroscopy; EPA Method 6010

III. Quality Control

Immediately following the analytical data for the samples can be found the QA/QC information that pertains to these samples. The purpose of this information is to demonstrate that the data enclosed is scientifically valid and defensible. This QA/QC data is used to assess the laboratory's performance during the analysis of the samples it accompanies. All quantitations were performed from within the calibrated range of the analytical instrument.

The lead analyses by Atomic Absorption were done in duplicate. The average is reported.

Client: USATHAMA
Work Order: X1-03-053
10305302

IT ANALYTICAL SERVICES
CINCINNATI, OH

Analytical Results, ug

Client Sample ID	Run # SIPM-1	Run # SIPM-2	Run # SIPM-3	
Lab No.	01	02	03	
Analyte				Detection Limit
Cadmium	14	14	7.5	2
Chromium	32	ND	ND	3
Lead	42	15	12	0.6
Zinc	62	ND	ND	5

Client Sample ID	Run # SIPM-4	Run # SIPM-5	
Lab No.	04	05	
Analyte			Detection Limit
Cadmium	6.6	8.3	2
Chromium	ND	29	3
Lead	4.4	15	0.6
Zinc	11	120	5

ND = Not detected above the reported detection limit

Client: USATHAMA
Work Order: X1-03-053
10305303

IT ANALYTICAL SERVICES
CINCINNATI, OH

Quality Assurance Data

Quality Control
Standard Reference Solutions

Analyte	Theoretical Value, mg/L	Percent Recovery
Cadmium	1	86.7, 95.8
Chromium	1	85.6, 87.8
Lead	0.75	92.0, 84.4
Zinc	1	80.4, 82.9

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant: RRAD-TEXARKANA   Run No.: SIPM-1

Sample Location VENTURI INLET   Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g   Lab #: X10305301B

Acetone Volume: [illegible] ml

Date & Time of Wt. 3/13/91 [illegible]:45AM   Beaker Gross Wt.: 104974.6 mg

Date & Time of Wt. 3/14/91 [illegible]:10AM   Beaker Gross Wt.: 104974.3 mg

Average Gross Wt.: 104974.5 mg

Beaker Tare Wt.: 104966.1 mg

Less acetone blank wt.: 1.3 mg

Particulate Wt.: 7.1 mg

Filter #: [illegible]   Lab #: [illegible]301A

Date & Time of Wt. [illegible]14/91 6:10AM   Filter Gross Wt.: 479.8 mg

Date & Time of Wt. 3/14/91 4:30PM   Filter Gross Wt.: 479.9 mg

Average Gross Wt.: 479.9 mg

Filter Tare Wt.: 469.2 mg

Weight of Particulate on Filter: 10.7 mg

Weight of Particulate in Acetone Rinse: 7.1 mg

Total Wt. of Particulate: 17.8 mg

Signature of Analyst: Melissa A. Ellesson   Date: 3-19-91

Signature of Reviewer: Ken Mueller   Date: 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant: KRAD-TEXARKANA   Run No.: S1PM-2

Sample Location VENTURI INLET   Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g   Lab #: X10305302B

Acetone Volume: 178 ml

Date & Time of Wt. [illegible] 8:45AM   Beaker Gross Wt.: 102989.0 mg

Date & Time of Wt. 3/14/91 8:10AM   Beaker Gross Wt.: 102988.6 mg

Average Gross Wt.: 102988.8 mg

Beaker Tare Wt.: 102983.2 mg

Less acetone blank wt.: 1.1 mg

Particulate Wt.: 4.5 mg

Filter # [illegible]   Lab #: X10305302A

Date & Time of Wt. 3/14/91 8:10AM   Filter Gross Wt.: 467.0 mg

Date & Time of Wt. 3/14/91 4:30PM   **Filter Gross Wt.: 467.1 mg**

Average Gross Wt.: 467.1 mg

Filter Tare Wt.: 464.1 mg

Weight of Particulate on Filter: 3.0 mg

Weight of Particulate in Acetone Rinse: **4.5 mg**

Total Wt. of Particulate: **7.5 mg**

Signature of Analyst: Melissa A. Ellysson   Date: 3-19-91

Signature of Reviewer: Ken Mueller   Date: 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant: ERAD-TEXARKANA | Run No.: SIPM-3

Sample Location VENTURI INLET | Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g | Lab #: X10305303B

Acetone Volume: 100 mL

Date & Time of Wt. 3/13/91 6:45AM | Beaker Gross Wt.: 101583.7 mg

Date & Time of Wt. 3/14/91 8:10AM | Beaker Gross Wt.: 101583.2 mg

Average Gross Wt.: 101583.5 mg

Beaker Tare Wt.: 101575.7 mg

Less acetone blank wt.: 0.7 mg

Particulate Wt.: 7.1 mg

Filter # 907[illegible] | Lab #: X10305303A

Date & Time of Wt. 3/14/91 8:10AM | Filter Gross Wt.: 472.2 mg

Date & Time of Wt. 3/14/91 4:30PM | Filter Gross Wt.: 472.2 mg

Average Gross Wt.: 472.2 mg

Filter Tare Wt.: 466.1 mg

Weight of Particulate on Filter: 6.1 mg

Weight of Particulate in Acetone Rinse: 7.1 mg

Total Wt. of Particulate: 13.2 mg

Signature of Analyst: Melissa A. Ellenger | Date: 3-19-91

Signature of Reviewer: Ken Mueller | Date: 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant: RRAD-TEXARKANA   Run No.: SIPM-4

Sample Location VENTURI INLET   Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g   Lab #: X10305304B

Acetone Volume: [illegible] ml

Date & Time of Wt. 3/13/91 8:45AM   Beaker Gross Wt.: 102961.8 mg

Date & Time of Wt. 3/14/91 8:10AM   Beaker Gross Wt.: 102961.4 mg

Average Gross Wt.: 102961.6 mg

Beaker Tare Wt.: 102954.6 mg

Less acetone blank wt.: 0.5 mg

Particulate Wt.: 6.5 mg

Filter # [illegible]   Lab #: X10305304A

Date & Time of Wt. 3/14/91 8:10AM   Filter Gross Wt.: 463.0 mg

Date & Time of Wt. 3/14/91 4:30PM   Filter Gross Wt.: 462.8 mg

Average Gross Wt.: 462.9 mg

Filter Tare Wt.: 457.8 mg

Weight of Particulate on Filter: 5.1 mg

Weight of Particulate in Acetone Rinse: 6.5 mg

Total Wt. of Particulate: 11.6 mg

Signature of Analyst: Date: 3-19-91

Signature of Reviewer: Date: 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant: [illegible]-TEXARKANA Run No.: SIPM-5

Sample Location VENTURI INLET Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g Lab #: X103053058

Acetone Volume: [illegible] ml

Date & Time of Wt. [illegible]/14/91 [illegible]AM Beaker Gross Wt.: 97018.4 mg

Date & Time of Wt. 3/14/91 4:00PM Beaker Gross Wt.: 97018.5 mg

Average Gross Wt.: 97018.5 mg

Beaker Tare Wt.: 97013.0 mg

Less acetone blank wt.: 0.6 mg

Particulate Wt.: 4.9 mg

Filter # [illegible] Lab #: X103053058A

Date & Time of Wt. [illegible] 14 91 4:[illegible]PM Filter Gross Wt.: 338.3 mg

Date & Time of Wt. 3/15/91 2:55PM Filter Gross Wt.: 338.2 mg

Average Gross Wt.: 338.3 mg

Filter Tare Wt.: 336.5 mg

Weight of Particulate on Filter: 1.8 mg

Weight of Particulate in Acetone Rinse: 4.9 mg

Total Wt. of Particulate: 6.7 mg

Signature of Analyst: Melissa A. Ellerson Date: 3-19-91

Signature of Reviewer: Ken Mueller Date: 4/1/91

INTERNATIONAL TECHNOLOGY CORPORATION

Laboratory Data

ITAS Cincinnati

Client: ITAQS USATHA

PN:

Date: 3 11 91

Extracted By: M Ellicessor

Analysis: EPA 5

Method Number: 07-015-00

Checker: KEM 4/1/91

Run#	Cont#	Lab#	Tare	VOL	3-13-91 8:45AM Gross	3-14-91 8:10AM Gross	3-14-91 4:00PM Gross	
SIPM 1	12213A	X1-03-053-01B	104.9661	~~229~~	104.9746	104.9743		
SIPM-2	11078A	02B	102.9832	178	102.9890	102.9886		
SIPM-3	11121A	03B	101.5757	169	101.5837	101.5832		
SIPM-4	11123A	04B	102.9546	90	102.9618	102.9614		
SIPM-5	11131A	05B	97.0130	95	97.0190	97.0184	97.0185	

Run#	Cont#	Lab#	F. Hec#	Tare	11:30AM 3-13-91 Gross	8:10AM 3-14-91 Gross	4:30PM 3-14-91 Gross	2:55pm 3-15-91
SIPM-1	12213B	X1-03-053-01A	9070054	.4692 ✓	.4811	.4798	.4799	
SIPM-2	11078B	02A	9070063	.4641 ✓	.4678	.4670	.4671	
SIPM-3	11121B	03A	9070025	.4661 ✓	.4737	.4722	.4722	
SIPM-4	11123B	04A	9070038	.4578 ✓	.4646	.4630	.4628	
SIPM-5	11131B	05A	9010500	.3365 ✓	.3407	.3394	~~.3379~~ .3385	.3382

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

ITAQS Cincinnati | Date: April 9, 1991

Attn: Mr. Chuck Bruffey

Job Number 21341 | P.O. Number 805625

This is the Certificate of Analysis for the following samples:

Client Project ID:	USATHAMA Project
Date Received:	March 5, 1991
Work Order:	X1-03-055
Number of Samples:	9
Sample Type:	Multi-Metals Trains

I. Introduction

Eight multi-metals trains and blanks arrived at ITAS Cincinnati on March 5, 1991. The samples were sent for analytical work in support of monitoring work on the USATHAMA Project. The samples are labeled as follows:

Run # SOPM-1
Run # SOPM-2
Run # SOPM-3
Run # SOPM-4
Run # SOPM-5
Run # SOPM-6
Run # SOPM-7
Run # SOPM-8
Run # Blank

II. Analytical Results/Methodology

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information, the analytical results, and the appropriate detection limits.

Each train consisted of a filter, acetone, and HNO3 impinger. The filter and acetone were analyzed per EPA 5. After EPA 5 analysis they were composited with the HNO3 impinger and analyzed for the metals listed on the next page.

Reviewed and Approved by:

Lam Rotelle for TS

Tim Soward
Project Manager
103055

IT Analytical Services • 11499 Chester Road • Cincinnati, OH 45246 • 513-782-4600

II. Analytical Results/Methodology (cont.)

* Lead by Graphite Furnace Atomic Absorption; EPA Method 7421

* Cadmium, Chromium and Zinc by Inductively Coupled Plasma Spectroscopy; EPA Method 6010

III. Quality Control

Immediately following the analytical data for the samples can be found the QA/QC information that pertains to these samples. The purpose of this information is to demonstrate that the data enclosed is scientifically valid and defensible. This QA/QC data is used to assess the laboratory's performance during the analysis of the samples it accompanies. All quantitations were performed from within the calibrated range of the analytical instrument.

The lead analyses by Atomic Absorption were done in duplicate. The average is reported.

Client: USATHAMA
Work Order: X1-03-055
10305502

IT ANALYTICAL SERVICES
CINCINNATI, OH

Analytical Results, ug

Client Sample ID	Run # SOPM-1	Run # SOPM-2	Run # SOPM-3	
Lab No.	01	02	03	
Analyte				Detection Limit
Cadmium	53	12	8.8	2
Chromium	650	ND	ND	3
Lead	1000 (1)	16	7.6	0.6
Zinc	1500	5.1	8.9	5

Client Sample ID	Run # SOPM-4	Run # SOPM-5	Run # SOPM-6	
Lab No.	04	05	06	
Analyte				Detection Limit
Cadmium	2.5	4.7	12	2
Chromium	ND	ND	4.5	3
Lead	5.9	13	19	0.6
Zinc	26	94	53	5

Client Sample ID	Run # SOPM-7	Run # SOPM-8	Run # Blank	
Lab No.	07	08	09	
Analyte				Detection Limit
Cadmium	ND	15	ND	2
Chromium	20	ND	9.6	3
Lead	22	12	2.4	0.6
Zinc	73	72	58	5

Client Sample ID	Blank Filter	
Lab No.	10	
Analyte		Detection Limit
Cadmium	2.4	2
Chromium	3.0	3
Lead	4.9	0.6
Zinc	63	5

(1) The detection limit for lead for this sample = 11 ug

ND = Not detected above the reported detection limit

Quality Assurance Data

Quality Control
Standard Reference Solutions

Analyte	Theoretical Value, mg/L	Percent Recovery
Cadmium	1	86.7, 95.8
Chromium	1	85.6, 87.8
Lead	0.75	92.0, 84.4
Zinc	1	80.4, 82.9

[illegible] Blank Analytical Data

[illegible]

Density of Acetone [illegible] g/ml (pa)

Blank Type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Container No.: [illegible] | Lab #: X10305509B

Volume of Acetone: [illegible] ml (Va)

Date & Time of Wt. [illegible] PM | Beaker Gross Wt.: 107376.1 mg.

Date & Time of Wt. [illegible] PM | Beaker Gross Wt.: 107375.9 mg.

Average Gross Wt.: 107376.0 mg.

Beaker Tare Wt.: 107373.9 mg.

$$C_a = \frac{(m_a)}{V_a\ (\rho_a)}$$

Beaker Net Wt.: 2.1 mg. (ma)

Acetone Blank Value: 0.0077 mg/g (Ca)

Blank Value used for Calculations: 0.0077 mg/g

Filter #: [illegible] | Lab #: X10305509A

Date & Time of Wt. 3/14/91 8:10AM | Filter Gross Wt.: 469.0 mg

Date & Time of Wt. 3/14/91 4:30PM | Filter Gross Wt.: 469.2 mg

Average Gross Wt.: 469.1 mg

Filter Tare Wt.: 468.2 mg

Difference: 0.9 mg

Remarks

Signature of Analyst: Melissa A. Ellason | Date: 3-19-91

Signature of Reviewer: Ken Mueller | Date: 4/1/91

Method 5 Blank Analytical Data

Plant: [illegible]

Density of Acetone 0.785? g/ml (pa)

Blank Type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone		
Filter	YES	YES

Acetone Blank Container No. ________ Lab #: ________

Volume of Acetone: ______ ml (Va)

Date & Time of Wt. ________ Beaker Gross Wt.: ______ mg.

Date & Time of Wt. ________ Beaker Gross Wt.: ______ mg.

Average Gross Wt.: 0.0 mg.

Beaker Tare Wt.: ______ mg.

$$Ca, (mg/g) = \frac{(ma)}{(Va)(pa)}$$

Beaker Net Wt.: 0.0 mg. (ma)

Acetone Blank Value: ERR mg/g (Ca)

Blank Value used for Calculations: ERR mg/g

Filter #: 9010498

Lab #: X10305510A

Date & Time of Wt. 3/14/91 8:10AM

Filter Gross Wt.: 336.7 mg ✓

Date & Time of Wt. 3/14/91 4:30PM

Filter Gross Wt.: 336.8 mg ✓

Average Gross Wt.: 336.8 mg

Filter Tare Wt.: 336.9 mg ✓

Difference: -0.1 mg

Remarks

Signature of Analyst: Melissa A. Ellason Date: 3-19-91

Signature of Reviewer: Ken Mueller Date: 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant: RRAD-TEXARKANA   Run No.: SOPM-1

Sample Location VENTURI OUTLET   Density of Acetone 0.7899 g/ml ✓

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g ✓   Lab #: X10305501B

Acetone Volume 750 ml ✓

Date & Time of Wt. 3/14/91 4:15PM   Beaker Gross Wt.: 103231.7 mg ✓

Date & Time of Wt. 3/15/91 8:00AM   Beaker Gross Wt.: 103231.6 mg ✓

Average Gross Wt.: 103231.7 mg

Beaker Tare Wt.: 103048.3 mg ✓

Less acetone blank wt.: 4.7 mg

Particulate Wt.: 176.7 mg

Weight of Particulate in Acetone Rinse: 176.7 mg

Filter # 807085   Lab #: X10305501A

Date & Time of Wt. 3/14/91 8:10AM   **Filter Gross Wt.: 670.0 mg** ✓

Date & Time of Wt. 3/14/91 4:30PM   **Filter Gross Wt.: 670.0 mg** ✓

Average Gross Wt.: 670.0 mg

Filter Tare Wt.: 421.6 mg ✓

Weight of Particulate on Filter: 248.4 mg

Signature of Analyst: Melissa A. Eliasson   Date: 3-19-91

Signature of Reviewer: Ken Mueller   Date: 4/1/91

Method 5 Train Analytical Particulate Data
Filters (Cont.)

Plant: RRAD-TEXARKANA Run No.: SOPM-1

Sample Location VENTURI OUTLET

Filter # 907008 Lab #: A1030500 1A

Date & Time of Wt. 3/14/91 8:10AM Filter Gross Wt.: 527.9 mg ✓

Date & Time of Wt. 3/14/91 4:30PM Filter Gross Wt.: 528.0 mg ✓

Average Gross Wt.: 528.0 mg

Filter Tare Wt.: 422.4 mg ✓

Weight of Particulate on Filter: 105.6 mg

Filter # Lab #:

Date & Time of Wt. Filter Gross Wt.: mg

Date & Time of Wt. Filter Gross Wt.: mg

Average Gross Wt.: 0.0 mg

Filter Tare Wt.: mg

Weight of Particulate on Filter: 0.0 mg

Weight of Particulate in Acetone Rinse: 178.7 mg ✓

Weight of Particulate on Filters: 354.0 mg ✓

Total Particulate: 532.7 mg

Comments:

Signature of Analyst: Melissa A. Ellison Date: 3-19-91

Signature of Reviewer: Ken Mueller Date: 8/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant: [illegible] Run No.: SOPM-2

Sample Location: VENTURI OUTLET Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc.: 0.0077 mg/g Lab #: X103055O2B

Acetone Volume: [illegible] ml

Date & Time of Wt. 3/14/91 4:15PM Beaker Gross Wt.: 103734.0 mg

Date & Time of Wt. 3/15/91 8:55AM Beaker Gross Wt.: 103734.4 mg

Average Gross Wt.: 103734.2 mg

Beaker Tare Wt.: 103721.2 mg

less acetone blank wt.: 0.8 mg

Particulate Wt.: 12.2 mg

Filter #: [illegible] Lab #: X103055O2A

Date & Time of Wt. [illegible] 8:10AM Filter Gross Wt.: 419.8 mg

Date & Time of Wt. 3/14/91 4:30PM Filter Gross Wt.: 419.8 mg

Average Gross Wt.: 419.8 mg

Filter Tare Wt.: 421.5 mg

Weight of Particulate on Filter: 0.0 mg

Weight of Particulate in Acetone Rinse: 12.2 mg

Total Wt. of Particulate: 12.2 mg

Signature of Analyst: Melissa A. Elkesson Date: 3-19-91

Signature of Reviewer: Ken Mueller Date: 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant: RRAD-TEXARKANA   Run No.: SOPM-3

Sample Location VENTURI OUTLET   Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g   Lab #: X10305503B

Acetone Volume: 115 ml

Date & Time of Wt. 3/14/91 4:15PM   Beaker Gross Wt.: 100566.2 mg

Date & Time of Wt. 3/15/91 8:55AM   Beaker Gross Wt.: 100565.8 mg

Average Gross Wt.: 100566.0 mg

Beaker Tare Wt.: 100558.2 mg

Less acetone blank wt.: 0.7 mg

Particulate Wt.: 7.1 mg

Filter # [illegible]   Lab #: X10305503A

Date & Time of Wt. 3/14/91 8:10AM   Filter Gross Wt.: 473.0 mg

Date & Time of Wt. 3/14/91 4:30PM   Filter Gross Wt.: 473.1 mg

Average Gross Wt.: 473.1 mg

Filter Tare Wt.: 471.6 mg

Weight of Particulate on Filter: 1.5 mg

Weight of Particulate in Acetone Rinse: 7.1 mg

Total Wt. of Particulate: 8.6 mg

Signature of Analyst: Melissa A. Ellingson   Date: 3-19-91

Signature of Reviewer: Kim Mueller   Date: 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant:[illegible] Run No.:SOPM-4

Sample LocationVENTURI OUTLET Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g Lab #:X10305504B

Acetone Volume: 120 ml

Date & Time of Wt.3/14/91 4:15PM Beaker Gross Wt.: 97563.2 mg

Date & Time of Wt.3/15/91 6:55AM Beaker Gross Wt.: 97562.8 mg

Average Gross Wt.: 97563.0 mg

Beaker Tare Wt.: 97557.0 mg

Less acetone blank wt.: 0.7 mg

Particulate Wt.: 5.3 mg

Filter # [illegible] Lab #:X10305504A

Date & Time of Wt.3/14/91 [illegible]:10AM Filter Gross Wt.: 469.7 mg

Date & Time of Wt.3/14/91 4:30PM Filter Gross Wt.: 469.8 mg

Average Gross Wt.: 469.8 mg

Filter Tare Wt.: 467.1 mg

Weight of Particulate on Filter: 2.7 mg

Weight of Particulate in Acetone Rinse: 5.3 mg

Total Wt. of Particulate: 8.0 mg

Signature of Analyst: Melissa A. Ellmann Date: 3-19-91

Signature of Reviewer: Ken Mueller Date: 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant: RRAD-TEXARKANA Run No.: SC M-5

Sample Location VENTURI OUTLET Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g Lab #: X10305505B

Acetone volume: [illegible] ml.

Date & Time of Wt. 3/14/91 4:15PM Beaker Gross Wt.: 102139.0 mg

Date & Time of Wt. 3/15/91 8:55AM Beaker Gross Wt.: 102138.8 mg

Average Gross Wt.: 102138.9 mg

Beaker Tare Wt.: 102109.3 mg

Less acetone blank wt.: 0.5 mg

Particulate Wt.: 29.1 mg

Filter # 9610495 Lab #: X10305505A

Date & Time of Wt. 3/14/91 8:10AM Filter Gross Wt.: 336.0 mg

Date & Time of Wt. 3/14/91 4:30PM Filter Gross Wt.: 336.1 mg

Average Gross Wt.: 336.1 mg

Filter Tare Wt.: 335.1 mg

Weight of Particulate on Filter: 1.0 mg

Weight of Particulate in Acetone Rinse: 29.1 mg

Total Wt. of Particulate: 30.1 mg

Signature of Analyst: Melissa A. Ellerson Date: 3-19-91

Signature of Reviewer: Ken Mueller Date: 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant: [illegible] Run No.: SOPM-6

Sample Location VENTURI OUTLET Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g Lab #: X10305506B

Acetone Volume: [illegible] ml

Date & Time of Wt. 3/14/91 4:15PM Beaker Gross Wt.: 105402.0 mg

Date & Time of Wt. 3/15/91 8:55AM Beaker Gross Wt.: 105401.9 mg

Average Gross Wt.: 105402.0 mg

Beaker Tare Wt.: 105393.2 mg

less acetone blank wt.: 0.9 mg

Particulate Wt.: 7.9 mg

Filter # [illegible] Lab #: X10305506A

Date & Time of Wt. [illegible]14/[illegible] 8:10AM Filter Gross Wt.: 339.8 mg

Date & Time of Wt. 3/14/91 4:30PM Filter Gross Wt.: 339.9 mg

Average Gross Wt.: 339.9 mg

Filter Tare Wt.: 339.1 mg

Weight of Particulate on Filter: 0.8 mg

Weight of Particulate in Acetone Rinse: 7.9 mg

Total Wt. of Particulate: 8.7 mg

Signature of Analyst: Melissa A. Ellessor Date: 3-19-91

Signature of Reviewer: Ken [illegible] Date: 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant:RRAD-TEXARKANA Run No.:SOPM-7

Sample LocationVENTURI OUTLET Density of Acetone 0.7899 g/ml ✓

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g ✓ Lab #:X10305507B

Acetone Volume: 224 ml. ✓

Date & Time of Wt.3/14/91 4:15PM Beaker Gross Wt.:102539.7 mg ✓

Date & Time of Wt.3/15/91 2:55PM Beaker Gross Wt.:102539.6 mg ✓

Average Gross Wt.:102539.7 mg

Beaker Tare Wt.:102532.0 mg ✓

Less acetone blank wt.: 1.4 mg

Particulate Wt.: 6.3 mg

Filter # 901049 Lab #:X10305507A

Date & Time of Wt 3/14/91 8:10AM Filter Gross Wt.: 335.4 mg ✓

Date & Time of Wt.3/14/91 4:30PM Filter Gross Wt.: 335.5 mg ✓

Average Gross Wt.: 335.5 mg

Filter Tare Wt.: 335.1 mg ✓

Weight of Particulate on Filter: 0.4 mg

Weight of Particulate in Acetone Rinse: 6.3 mg

Total Wt. of Particulate: 6.7 mg

Signature of Analyst: Melissa A. Ellerson Date: 3-19-91

Signature of Reviewer: Ken Mueller Date: 4/1/91

Method 5 Train Analytical Particulate Data
Acetone Rinses and Filter(s)

Plant: RRAP-TEXARKANA Run No.: SOPM-6

Sample Location VENTURI OUTLET Density of Acetone 0.7899 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone	YES	YES
Filter	YES	YES

Acetone Blank Residue Conc. 0.0077 mg/g Lab #: X10305508B

Acetone Volume: [illegible] ml.

Date & Time of Wt. 3/14/91 4:10PM	Beaker Gross Wt.:	102467.4 mg
Date & Time of Wt. 3/18/91 9:00AM	Beaker Gross Wt.:	102467.1 mg
	Average Gross Wt.:	102467.3 mg
	Beaker Tare Wt.:	102457.3 mg
	Less acetone blank wt.:	0.8 mg
	Particulate Wt.:	9.2 mg

Filter # 9010533 Lab #: X10305508A

Date & Time of Wt. 3/14/91 [illegible]:10AM	Filter Gross Wt.:	331.0 mg
Date & Time of Wt. 3/14/91 4:30PM	Filter Gross Wt.:	331.1 mg
	Average Gross Wt.:	331.1 mg
	Filter Tare Wt.:	331.4 mg
	Weight of Particulate on Filter:	0.0 mg
	Weight of Particulate in Acetone Rinse:	9.2 mg
	Total Wt. of Particulate:	9.2 mg

Signature of Analyst: Melissa A. Elfassion Date: 3-19-91
Signature of Reviewer: Ken Mueller Date: 4/1/91

INTERNATIONAL TECHNOLOGY CORPORATION

Laboratory Data

ITAS Cincinnati

Client: ITAQS USATHA	Analysis: EPA 5
PN: / Date: 3-11-91	Method Number: 07-015-00
Extracted By: M. Elicessor	Checker: KPM 4/1/91

Run#	Cont#	Lab#	Tare	Vol	3-14-91 4:15pm Gross	3-15-91 8:55am Gross	3-15-91 2:55pm Gross	3-18-91 9:00 Gross
SOPM-1	~~11054A~~ 11075A	X-1-03-055-01B	103.0483	3465	103.2317	103.2309		103.2376 103.2614
SOPM-2	11076A	02B	103.7212	138	103.7340	103.7344		
SOPM-3	11119A	03B	100.5582	115	100.5662	100.5658		
SOPM-4	11127A	04B	97.5570	120	97.5632	97.5628		
SOPM-5	11129A	05B	102.1093	85	102.1390	102.1388		
SOPM-6	11135A	06B	105.3932	145	105.4020	105.4019		
SOPM-7	11141A	07B	102.5320	224	102.5397	102.5389	102.5396	
SOPM-8	11143A	08B	102.4573	132	102.4674	102.4657	102.4683	102.4671
Blank	12209A	09B	107.3739	345	107.3761	107.3753	107.3759	

Run#	Cont#	Lab#	Filter	Tare	3-13-91 11:30Am Gross	3-14-91 8:10Am Gross	4:30pm 3-14-91 Gross
SOPM-1	12215B	X-1-03-055-01A	9070053	.4216	.6706	.6700	.6700
		01A	9070069	.4224	.5289	.5279	.5280
SOPM-2	11076B	02A	9070066	.4215	.4209	.4198	.4198
SOPM-3	11119B	03A	9070093	.4716	.4744	.4730	.4731
SOPM-4	11127B	04A	9070021	.4671	.4705	.4697	.4698
SOPM-5	11129B	05A	9010493	.3351	.3370	.3360	.3361
SOPM-6	11135B	06A	9010503	.3391	.3406	.3398	.3399
SOPM-7	11141B	07A	9010488	.3351	.3364	.3354	.3355
SOPM-8	11143B	08A	9010535	.3314	.3318	.3310	.3311
Blank ~~SOPM-9~~	11074B	09A	9070094	.4682 ~~.3369~~	.4696	.4690	.4692
Blank	11126B	10A	9010499	.3369	.3375	.3367	.3368

M-D-11/80

INTERNATIONAL TECHNOLOGY CORPORATION

CHAIN-OF-CUSTODY RECORD

R/A Control No. ______

C/C Control No. 158922

PROJECT NAME/NUMBER ______ LAB DESTINATION ______

SAMPLE TEAM MEMBERS ______ CARRIER/WAYBILL NO. ______

Sample Number	Sample Location and Description	Date and Time Collected	Sample Type	Container ~~Type~~ No.	Condition on Receipt (Name and Date)	Disposal Record No
SIPM-5		2/27	Part/Metals	Acc. - 11131-A	SAMPLES REC'D	
				F - 11131-B		
				HNO_3/H_2O_2 - 11132-A/N	GOOD	
SOPM-1	Scrubber Outlet	2/26	"	Acc. - 11076-A; 11054-A	CONDITION	
				Filters - 9070053-B 9070067-B	3/5/91	
				HNO_3/H_2O_2 - 12215-A 11074-A		
SOPM-2		2/26		Acc. - 11076 A		
				F - 11076 B		
				Soln. - 11077 A		
SOPM-3		2/27		Acc. - 11119-A		
				F - 11119-B		
				Soln. - 11120-A		

Special Instructions: ______

Possible Sample Hazards: ______

SIGNATURES: (Name, Company, Date and Time)

1. Relinquished By: [illegible] 3/4/91

Received By: [illegible], TBS, 3/5/91 1340

2. Relinquished By: ______

Received By: ______

3. Relinquished By: ______

Received by: ______

4. Relinquished By: ______

Received By: ______

INTERNATIONAL TECHNOLOGY CORPORATION

CHAIN-OF-CUSTODY RECORD

R/A Control No. ____

C/C Control No. 158923

PROJECT NAME/NUMBER ____ LAB DESTINATION ____

SAMPLE TEAM MEMBERS ____ CARRIER/WAYBILL NO. ____

Sample Number	Sample Location and Description	Date and Time Collected	Sample Type	Container Type	Condition on Receipt (Name and Date)	Disposal Record No
SoPM-4		2/27	Part/Metals	Acc.-11127-A F-11127-B SoLN.-11128-A	SAMPLES REC'D IN GOOD CONDITION. 3/5/91	
SoPM-5		2/27	"	Acc.-11129-A F-11127-B SoLN.-11130-A		
SoPM-6		2/28	"	Acc.-11135-A F-11135-B SoLN.-11136-A		
SoPM-7		2/28		Acc.-11141-A F-11141-B SoLN.-11142-A		
SoPM-8		2/28		Acc.-11143-A F-11143-B Soln.-11144-A		

Special Instructions: ____

Possible Sample Hazards: ____

SIGNATURES: (Name, Company, Date and Time)

1. Relinquished By: [signature] 3/5/91

   Received By: [signature] 3/5/91 1340

2. Relinquished By: ____

   Received By: ____

3. Relinquished By: ____

   Received by: ____

4. Relinquished By: ____

   Received By: ____

INTERNATIONAL TECHNOLOGY CORPORATION

CHAIN-OF-CUSTODY RECORD

R/A Control No. ______

C/C Control No. 158921

PROJECT NAME/NUMBER ______

LAB DESTINATION ______

SAMPLE TEAM MEMBERS ______

CARRIER/WAYBILL NO. ______

Sample Number	Sample Location and Description	Date and Time Collected	Sample Type	Container ~~Type~~ No.	Condition on Receipt (Name and Date)	Disposal Record No
SIPM-1	Venturi Inlet	2/26	Part/Metals	Acc. - 12213-A F - 12213-B HNO_3/H_2O_2 - 12214-A	SAMPLES REC'D IN GOOD CONDITION 3/5/91	
SIPM-2	"	2/26	"	Acc. - 11078-A F - 11078-B HNO_3/H_2O_2 - 11079-A		
SIPM-3	"	2/27	"	Acc. - 11121-A F - 11121-B HNO_3/H_2O_2 - 11122-A		
SIPM-4		2/27	"	Acc. - 11123-A F - 11123-B HNO_3/H_2O_2 - 11124-A		

Special Instructions: ______

Possible Sample Hazards: ______

SIGNATURES: (Name, Company, Date and Time)

1. Relinquished By: [illegible] 3/4/91

   Received By: [illegible] ITAS 3/5/91 1340

2. Relinquished By: ______

   Received By: ______

3. Relinquished By: ______

   Received by: ______

4. Relinquished By: ______

   Received By: ______

INTERNATIONAL TECHNOLOGY CORPORATION

CHAIN-OF-CUSTODY RECORD

R/A Control No. ______

C/C Control No. 158920

PROJECT NAME/NUMBER ______ LAB DESTINATION ______

SAMPLE TEAM MEMBERS ______ CARRIER/WAYBILL NO. ______

Sample Number	Sample Location and Description	Date and Time Collected	Sample Type	Container Type	Condition on Receipt (Name and Date)	Disposal Record No
AIPM-5		2/27	Part./Metals	Acc. - 11133-A	SAMPLES REC'D	
				F - 11133-B	IN GOOD CONDITION,	
				HNO3/H2O2 - 11134-A		
AIPM-6		2/28	"	Acc. - 11137-A	3/5/91	
				F - 11137-B		
				HNO3/H2O2 - ~~[illegible]~~ 11138-A		
AIPM-7		2/28	"	Acc. - 11139-A		
				F - 11139-B		
				HNO3/H2O2 - 11140-A		
AIPM-8		2/28	"	Acc. - 11145-A		
				Filter - 11145-B		
				HNO3/H2O2 - 11146-A		

Special Instructions: ______

Possible Sample Hazards: ______

SIGNATURES: (Name, Company, Date and Time)

1. Relinquished By: [illegible] 3/4/91

Received By: [illegible] 3/5/91 1340

2. Relinquished By: ______

Received By: ______

3. Relinquished By: ______

Received by: ______

4. Relinquished By: ______

Received By: ______

INTERNATIONAL TECHNOLOGY CORPORATION

CHAIN-OF-CUSTODY RECORD

R/A Control No. ______

C/C Control No. 158919

PROJECT NAME/NUMBER USATHAMA JTS: 805625

LAB DESTINATION ITAS - Cinn.

SAMPLE TEAM MEMBERS C. Buffey / P. Fitzgerald

CARRIER/WAYBILL NO. ______

Sample Number	Sample Location and Description	Date and Time Collected	Sample Type	Container ~~Type~~ No.	Condition on Receipt (Name and Date)	Disposal Record No
AIPM-1	Afterburner Inlet	2/26	Part./Metals	Acc. - 12208-A	Samples Rec'd	
				Filter - 12208-B	in good condition,	
				HNO_3/H_2O_2 - 12210-A		
AIPM-2	"	2/26	"	Acc. - 11080-A	3/5/91	
				Filter - 11080-B		
				HNO_3/H_2O_2 - 11081-A		
AIPM-3	"	2/27	"	Acc. - 11030-A		
				Filter - 11030-B		
				HNO_3/H_2O_2 - 11118-A		
AIPM-4	"	2/27	"	Acc. - 11125-A		
				Filter - 11125-B		
				HNO_3/H_2O_2 - 11126-A		

Special Instructions: ______

Possible Sample Hazards: ______

SIGNATURES: (Name, Company, Date and Time)

1. Relinquished By: C. Buffey 3/5/91

   Received By: [signature] ITAS, 3/5/91 1340

2. Relinquished By: ______

   Received By: ______

3. Relinquished By: ______

   Received by: ______

4. Relinquished By: ______

   Received By: ______

INTERNATIONAL TECHNOLOGY CORPORATION

CHAIN-OF-CUSTODY RECORD

R/A Control No. ____

C/C Control No. 158924

PROJECT NAME/NUMBER ____ LAB DESTINATION ____

SAMPLE TEAM MEMBERS ____ CARRIER/WAYBILL NO. ____

Sample Number	Sample Location and Description	Date and Time Collected	Sample Type	Container Type	Condition on Receipt (Name and Date)	Disposal Record No
Nos. 1-6	Sand	2/26 & 2/28	Metals	Glass Jar	SAMPLES REC'D	
					IN GOOD CONDITION.	
Nos. 030 thru 034	Water	2/26 & 28	Metals	1/2 gal. Jar	3/5/91	
					DUP. #3B NOT	
	Blanks				RECEIVED, 3/5/91	
12208-A	Aceton Blank.					
12211-A	HNO3/H2O Blank.					
[redacted]						
Pallflex	Filter (#11074-B Filter-9070094)					
Glass Fiber Filter (Lot. 11126-B)						

Special Instructions: ____

Possible Sample Hazards: ____

SIGNATURES: (Name, ~~Company,~~ Date and Time)

1. Relinquished By: [signature] 3/5/91

Received By: [signature] 3/5/91 1340

2. Relinquished By: ____

Received By: ____

3. Relinquished By: ____

Received by: ____

4. Relinquished By: ____

Received By: ____

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

ITAQS Cincinnati Date: April 29, 1991

Attn: Mr. Chuck Bruffey

Job Number 21341 P.O. Number 805625

This is the Certificate of Analysis for the following samples:

Client Project ID:	USATHAMA
Date Received:	March 5, 1991
Work Order:	X1-04-146
Number of Samples:	2
Sample Type:	Water

I. Introduction

Two water samples arrived at ITAS Cincinnati on March 5, 1991. The samples were sent for analytical work in support of monitoring work on the USATHAMA Project. The samples are labeled as follows:

Water # 31
Water # 32

II. Analytical Results/Methodology

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information, the analytical results, and the appropriate detection limits.

The analyses requested are listed on the following page.

Reviewed and Approved by:

Timothy Soward

Timothy Soward
Project Manager
104146

American Council of Independent Laboratories
International Association of Environmental Testing Laboratories
American Association for Laboratory Accreditation

IT Analytical Services • 11499 Chester Road • Cincinnati, OH 45246 • 513-782-4600

_. Analytical Results/Methodology (cont.)

* Lead by Graphite Furnace Atomic Absorption; EPA Method 7421

* Cadmium, Chromium and Zinc by Inductively Coupled Plasma Spectroscopy; EPA Method 601

III. Quality Control

Immediately following the analytical data for the samples can be found the QA/QC information that pertains to these samples. The purpose of this information is to demonstrate that the data enclosed is scientifically valid and defensible. This QA/QC data is used to assess the laboratory's performance during the analysis of the samples it accompanies. All quantitations were performed from within the calibrated range of the analytical instrument.

Client: USATHAMA
Work Order: X1-04-146
10414603

IT ANALYTICAL SERVICES
CINCINNATI, OH

Analytical Results, mg/L

Client Sample ID	Water # 31	Water # 32	
Lab No.	08	09	
Analyte			Detection Limit
Cadmium	0.002	ND	0.002
Chromium	0.030	0.007	0.006
Lead	0.0041	0.0007	0.0007
Zinc	0.031	0.021	0.008

ND = Not detected above the reported detection limit

Quality Assurance Data

Quality Control
Standard Reference Solutions

Analyte	Theoretical Value	Percent Recovery
Cadmium	1	98.8
Chromium	1	101
Lead	0.075	96.5
Zinc	1	99.8

APPENDIX D

SAMPLING AND ANALYTICAL PROCEDURES

SAMPLING AND ANALYTICAL PROCEDURES

This Appendix details the sampling and analytical methods used in this test program. These are generic descriptions with modifications detailed as follows:

- Determination of Particulate and Trace Metal Emissions

  The method as written is applicable to the measurement of trace metal emissions including mercury. The additional impinger solution (potassium permanganate) and recovery and analytical procedures specific to mercury analysis will not be used in this test series, since mercury is not a metal analyte of interest. The potassium permanganate impingers will be replaced by an empty impinger followed by an impinger containing silica gel.

- Determination of Total Gaseous Organic Concentration by U.S. EPA Method 25A

  No modifications as written.

Title: 25A
Date: 10/16/90

DETERMINATION OF TOTAL GASEOUS ORGANIC CONCENTRATION BY EPA METHOD 25A

Sampling and analysis procedures for determining total gaseous organic emissions are those described in EPA Method 25A.* Gas flow rates are determined by using EPA Methods 1 and 2 for velocity and temperature, a Fyrite or Orsat analyzer for oxygen and carbon dioxide content, and wet bulb/dry bulb temperature measurements for moisture content. The following is a detailed description of Method 25A equipment and procedures.

Sampling Apparatus

The sampling apparatus is shown in Figure 25A-1. The system is set up and operated in accordance with the guidelines in the operating manual for the total hydrocarbon monitor. In addition to the hydrocarbon analyzer, the sampling system consists of:

Particulate Filter - A short piece of 1/2-in.-i.d. pipe packed with glass wool and attached to the end of the sample probe, if needed, or equivalent.

Sample Probe - Stainless steel tubing inserted into the gas stream being sampled. A three-way ball valve at the outlet of the probe is used to add calibration gas.

Sample Line - 1/4-in.-o.d. heated Teflon line self-limited to maintain a sample temperature between 250° and 300°F.

Sampling Manifold - One stainless steel three-way valve and 1/4-in. stainless steel tubing are used to supply calibration standards and sample gas to the monitor. One three-way valve is used to select calibration injections or to sample stack gas. The whole system is wrapped with heat tape.

* 40 CFR 60, Appendix A, July 1990.

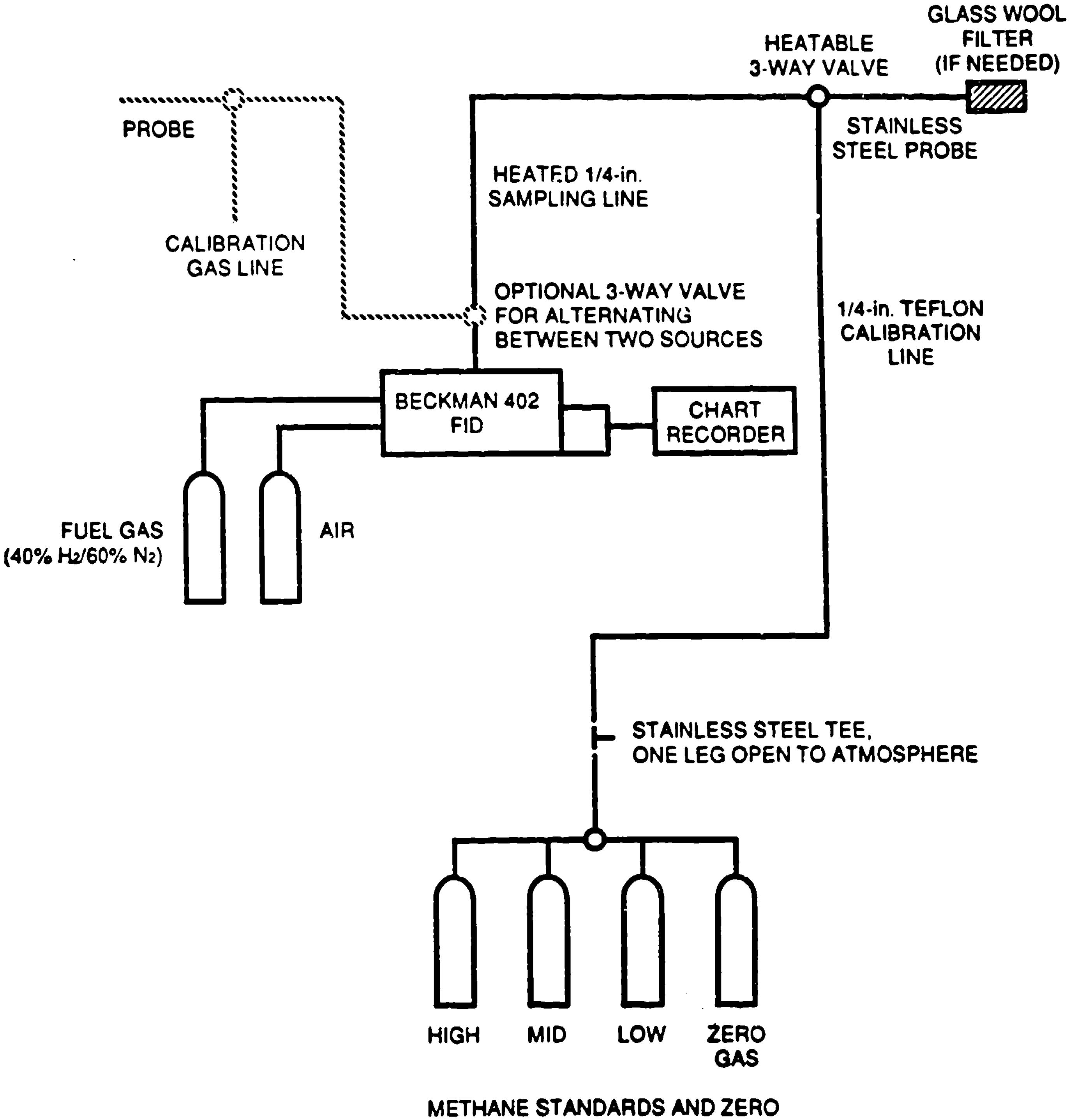


Figure 25A-1. Method 25A sampling system.

Calibration Gases - Methane standards in air and zero nitrogen (less than 0.1 ppm THC) are used to calibrate the monitor.

Fuel and Air - A cylinder of 40 percent hydrogen/60 percent nitrogen and a cylinder of compressed air to provide fuel and an air supply for the analyzer's flame.

Chart Recorder - A Heath strip-chart recorder or equivalent is used to provide a permanent record of hydrocarbon concentration data.

A Beckman 402 total hydrocarbon analyzer that works on the principle of flame ionization is used. All critical sample-handling components of the analyzer are contained in a heat-controlled oven. The oven temperature is maintained at 250°F throughout the test program. The following analyzer specifications were provided by the manufacturer:

Full-scale sensitivity:	Adjustable from 5 ppm methane to 10,000 ppm (%) methane
Response time (0 to 99%):	Less than 1 s for oven temperature of 200°F Less than 1.5 s for oven temperature of 400°F
Electricity stability:	±1 percent of full scale per 24 hours, with ambient temperature change of less than 10°F
Reproducibility:	±1 percent of full scale for successive identical samples
Output:	Selectable from 10 mV, 100 mV, or 1V.

The magnitude of the analyzer response to carbon atoms depends on the chemical environment of this atom in its molecule. Typical ratios of monitor response to methane for carbon atoms in various molecular structures are listed in Table 25A-1.

TABLE 25A-1. MONITOR RESPONSE FOR VARIOUS MOLECULAR STRUCTURES

Molecular structure	Response relative to methane, %
Aliphatic compound	100
Aromatic compound	100
Olefinic compound	95
Acetylenic compound	130
Carbonyl radical	0
Nitrile radical	30

Monitor Setup and Calibration

The monitor setup and check procedures outlined here are performed prior to sampling. The monitor is calibrated by introducing zero and high-level calibration gases to the calibration port of the sampling manifold. The predicted response for low- and mid-level calibration gases is calculated, assuming that the monitor response is linear. The low- and mid-level gases are then introduced into the monitor. If actual responses for the gases differed from the predicted responses by more than 5 percent, the monitoring system is inspected and repaired before sampling begins.

Once the monitor is calibrated, a system integrity check is performed. Zero nitrogen and one of the methane standards are sampled through the sample probes and lines to make sure that the sampling system is not diluting or contaminating the samples. A stainless steel tee with a leg left open to the atmosphere is placed on the end of the probe during this step so that calibration gases being sent from the cylinders do not pressurize the sampling system.

Once the sample lines are checked out, a response-time test is performed. This test consists of introducing zero gas to the probes and switching to high-level calibration gas when the system is stabilized. The response time is the time from the concentration change until the measurement system response, and it is equivalent to 95 percent of the response for the high-level calibration gas. The test is performed three times, and results are averaged.

Sampling Procedures

At the start of the test day, the monitor is calibrated and a system integrity check is performed. Each sample line is also leak-checked by capping the end of the probe and observing the sample flow rotameter level on the hydrocarbon monitor. If no flow is indicated by the rotameter, the leak check is considered acceptable.

Daily calibrations for each range are performed with three calibration standards (low-level, mid-level, and high-level) and zero nitrogen. Each calibration range is checked by linear regression calculations, which indicate linear responses and are used to reduce field data.

When sampling is completed, a calibration drift check is performed on the monitor by introducing the zero and mid-level calibration gas to the monitor. If the calibration drifts for the gases do not exceed 2 percent of span, the pretest calibration curve is used to report sample results. If the calibration drift for either gas exceeds 2 percent, the monitor is recalibrated and both sets of calibration data are used in reporting the results.

DETERMINATION OF PARTICULATE AND METAL EMISSIONS

Sampling for filterable particulate matter and total metals (particulate and gaseous) emissions was conducted in accordance with the Methodology for the Determination of Trace Metal Emissions in Exhaust Gases From Stationary Source Combustion Processes.* This is the same procedure as that in Subsection 3.1 of the Methods Manual for Compliance with BIF Regulations.** The particulate determination in this method is consistent with EPA Method 5.***

Sampling Apparatus

The sampling train used in these tests is assembled by ITAQS personnel and meets all design specifications established by the U.S. EPA. The sampling apparatus consists of:

Nozzle - Borosilicate glass with an accurately measured round opening.

Probe - Borosilicate glass with a heating system capable of maintaining a minimum gas temperature of 250°F at the exit end during sampling.

Pitot Tube - A Type-S pitot tube that meets all geometric standards is used to measure gas velocity during each sampling run.

Temperature Gauge - Type-K thermocouple attached to the pitot tube in an interference-free arrangement with a digital readout to monitor stack gas temperature within 5°F.

Filter Holder - Pyrex glass with a heating system capable of maintaining a filter temperature of 250° ±25°F.

Filter - 87-mm (3-in.)-diameter, Pallflex Type 2500 QAT-UP ultra-pure filter.

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* EPA Draft Protocol, July 1988.

** EPA/530-SW-91-010, December 1990.

*** 40 CFR 60, Appendix A, July 1990.

Draft Gauge - An inclined manometer made by Dwyer with a readability of 0.01 in.H_2O in the 0- to 10-in.H_2O range is used.

Impingers - Five Greenburg-Smith design impingers connected in series with glass ball joints. The first, third, and fifth impingers are modified by removing the tip and extending the tube to within 1.3 cm (0.5 in.) of the bottom of the flask.

Metering System - Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 2.8°C (5°F), calibrated dry gas meter, and related equipment to maintain an isokinetic sampling rate and to determine sample to volume. The dry gas meter is made by Rockwell, and the fiber vane pump is made by Gast.

Barometer - Aneroid tube type to measure atmospheric pressures to ±2.5 mmHg (±0.1 in.Hg).

Sampling Procedure

Pallflex filters are desiccated for at least 24 hours and weighed to the nearest 0.1 mg on an analytical balance. One hundred mL of 5 percent nitric acid/10 percent hydrogen peroxide solution are placed in each of the first two impingers; the third and fourth impingers contain 100 mL of acidic potassium permanganate solution; and the last impinger contains 200 to 400 g of silica gel.

The train is set up with the probe as shown in Figure PMM-1. The sampling train is leak-checked at the sampling site prior to each test run by plugging the inlet to the nozzle and pulling a 15-in.Hg vacuum, and at the conclusion of the test by plugging the inlet to the nozzle and pulling a vacuum equal to the highest vacuum reached during the test run.

The pitot tube and lines are leak-checked at the test site prior to and at the conclusion of each test run. This check is made by blowing into the impact opening of the pitot tube until 3 or more inches of water is recorded on the manometer and then capping the impact opening and holding it for 15 seconds to ensure that it is leak free. The static-pressure side of the pitot tube is leak-checked by the same procedure, except suction is used to obtain the 3-in.H_2O manometer reading.

Crushed ice is placed around the impingers to keep the temperature of the gas leaving the last impinger at 68°F or less. During sampling, stack gas and sampling

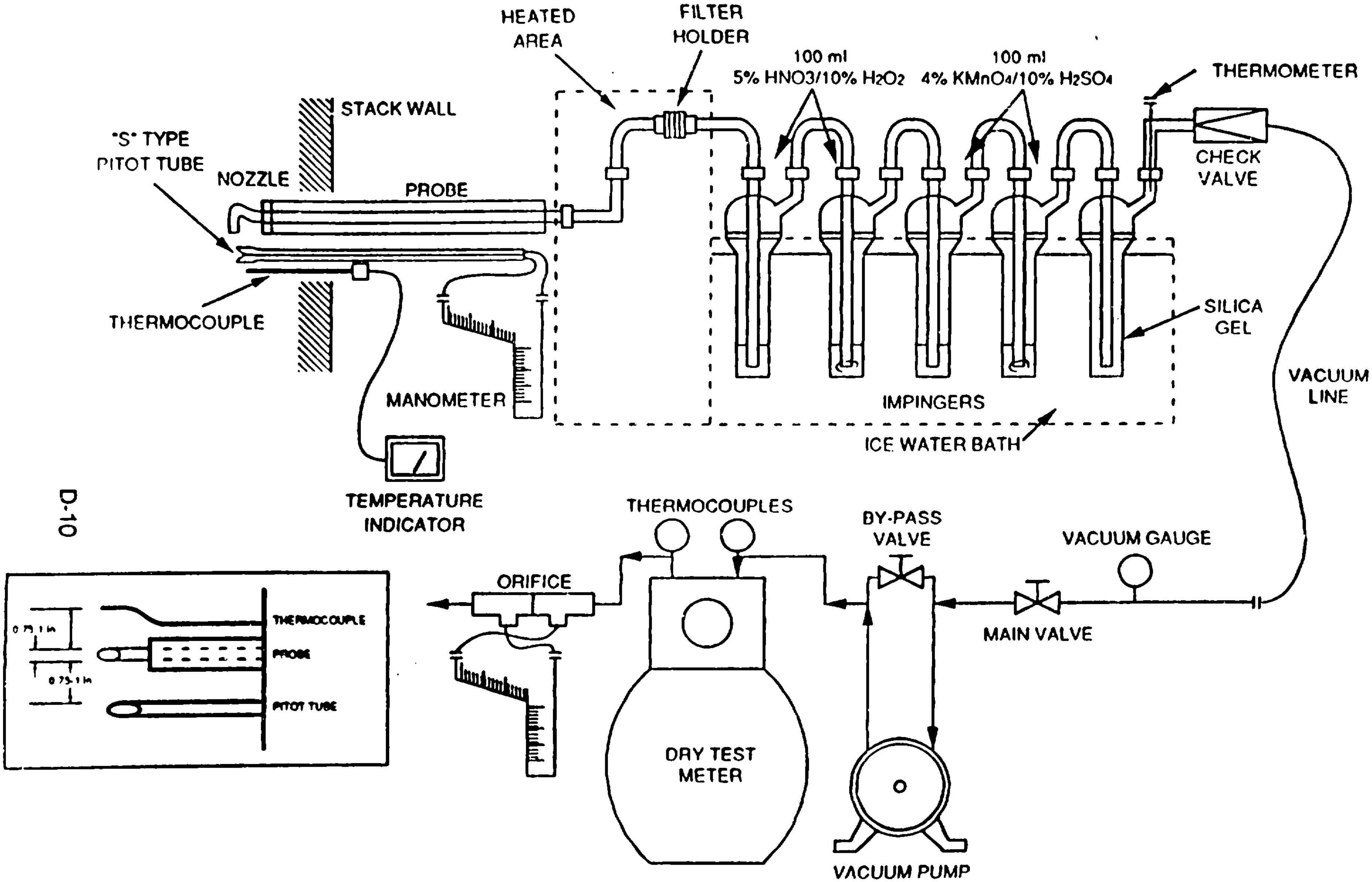


Figure PMM-1. Particulate/metals sampling train.

train data are recorded at each sampling point. Sampling rates are determined with the aid of a programmable calculator, and all sampling data are recorded on the Emission Testing Field Data Sheet.

Recovery Procedures

Upon completion of each sample run, the sampling train is allowed to cool and is then disassembled into sections. The probe and impinger sections are sealed and carefully transported to the cleanup area.

The amount of moisture collected is determined volumetrically using a graduated cylinder or by weighing each impinger before and after the sample run. After being weighed, the silica gel is discarded. Figure PMM-2 is a schematic of the sample recovery performed on the different sample fractions. The samples are recovered as follows:

Container No. 1 - The filter is placed into a petri dish, sealed, and labeled.

Container No. 2 - The filter holder, probe, and nozzle are rinsed with acetone to recover particulate. A nylon brush is used to remove particulate. The rinse is recovered in a glass jar.

Container No. 3 - The nozzle, probe, and filter holder front halves are rinsed with 0.1 N HNO_3 into a leak-free polyethylene container.

The contents of the first two impingers and a 0.1 N HNO_3 rinse of the filter holder backhalf and connecting glassware are placed in the same leak-free polyethylene container. The container is sealed and labeled, and the liquid level is marked.

Container No. 4 - The contents of the third and fourth impingers and an acidified potassium permanganate rinse are placed in an amber glass container. The container is sealed and labeled, and the liquid level is marked.

Blanks of each reagent are taken in the field for preparation and analysis in a manner identical to that for the samples. For each project, the blanks consist of one or more of the following:

1) Field blank - A sampling train is set up, leak-checked, recovered, and analyzed as a sample.

Title: PMM
Date: 4/17/91

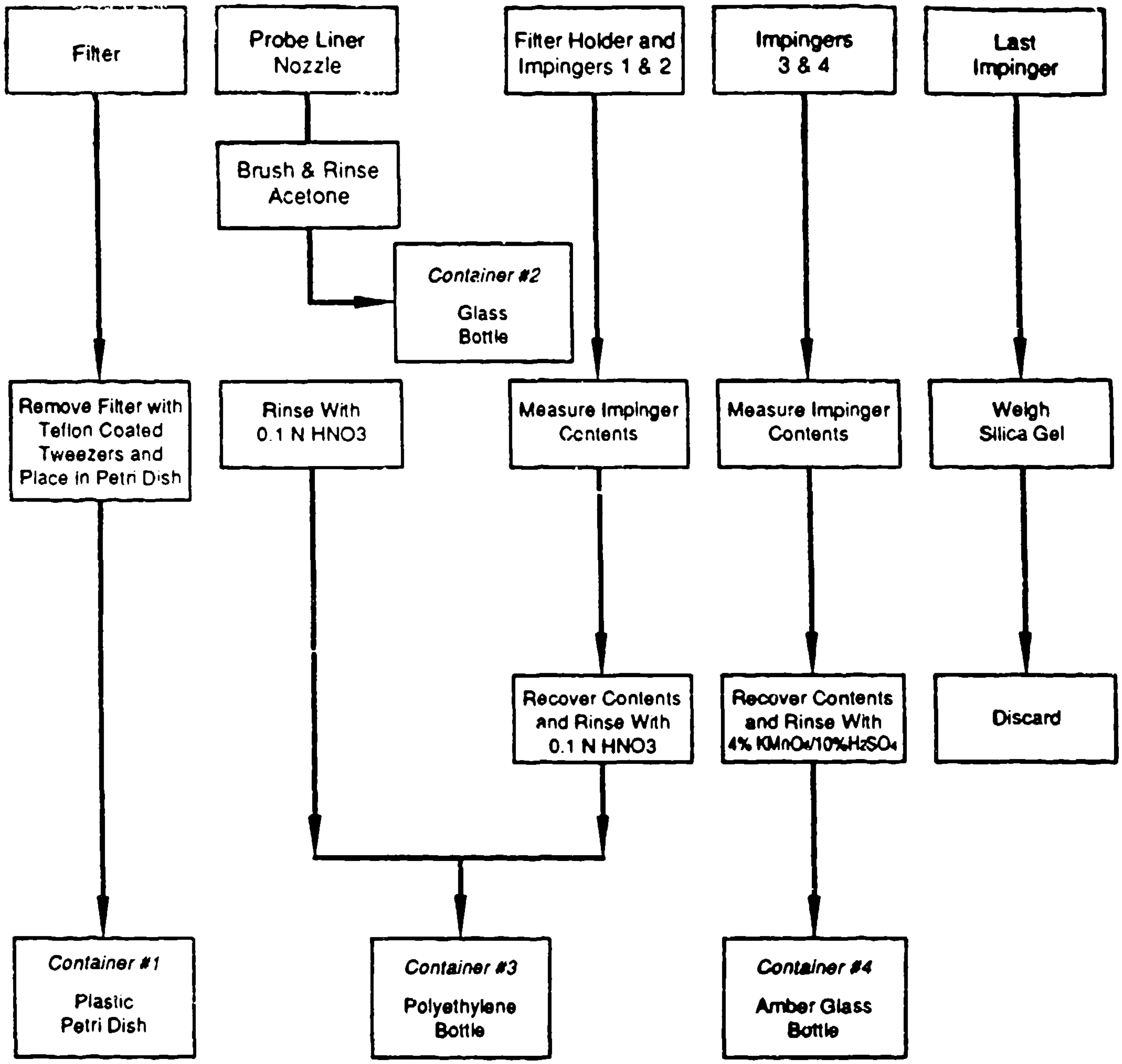


Figure PMM-2. Multimetals train recovery procedures.

2) Reagent blank - A sample of each reagent used is taken and analyzed either separately or by combining them in the same proportion as that used for samples.

3) Blank spike - A set of blank reagents is taken and combined in the same proportion as was used for the samples. Prior to analysis, the blank set is spiked with a known amount of each metal.

A diagram illustrating sample preparation and analysis procedures for each of the sample train components is shown in Figure PMM-3.

Sample Preparation and Analysis, Particulate

Container No. 1 - The filter and any loose particulate matter from this sample are placed into a tared weighing dish, desiccated for 24 hours to a constant weight, and weighed to the nearest 0.1 mg.

Container No. 2 - The acetone washings are transferred to a tared beaker and evaporated to dryness at ambient temperature and pressure, desiccated for 24 hours to a constant weight, and weighed to the nearest 0.1 mg.

Sample Preparation and Analysis, Metals

Container Nos. 1 and 2 - The filter with its filter catch and the acetone residue are divided into portions containing approximately 0.5 g each and placed into the analyst's choice of either individual microwave pressure-relief vessels or Parr® Bombs. Six mL of concentrated nitric acid and 4 mL of concentrated hydrofluoric acid are added to each vessel. For microwave heating, the sample vessels are microwaved for approximately 12 to 15 minutes (in intervals of 1 to 2 minutes) at 600 Watts. For conventional heating, the Parr Bombs are heated at 140°C (285°F) for 6 hours. The samples are then cooled to room temperature and combined with the acid-digested probe rinse.

Container No. 3 - If necessary, the pH of this sample is lowered to 2 with concentrated nitric acid. After pH adjustment, the sample is rinsed into a beaker with water, and the beaker is covered with a ribbed watchglass. The sample volume is reduced to approximately 20 mL by heating on a hot plate at a temperature just below boiling. The sample is then digested as follows:

a) 30 mL of 50 percent nitric acid is added to the sample, and the solution is heated for 30 minutes on a hot plate at a temperature just below boiling.

b) 10 mL of 3 percent hydrogen peroxide is added, and the solution is heated for an additional 10 minutes.

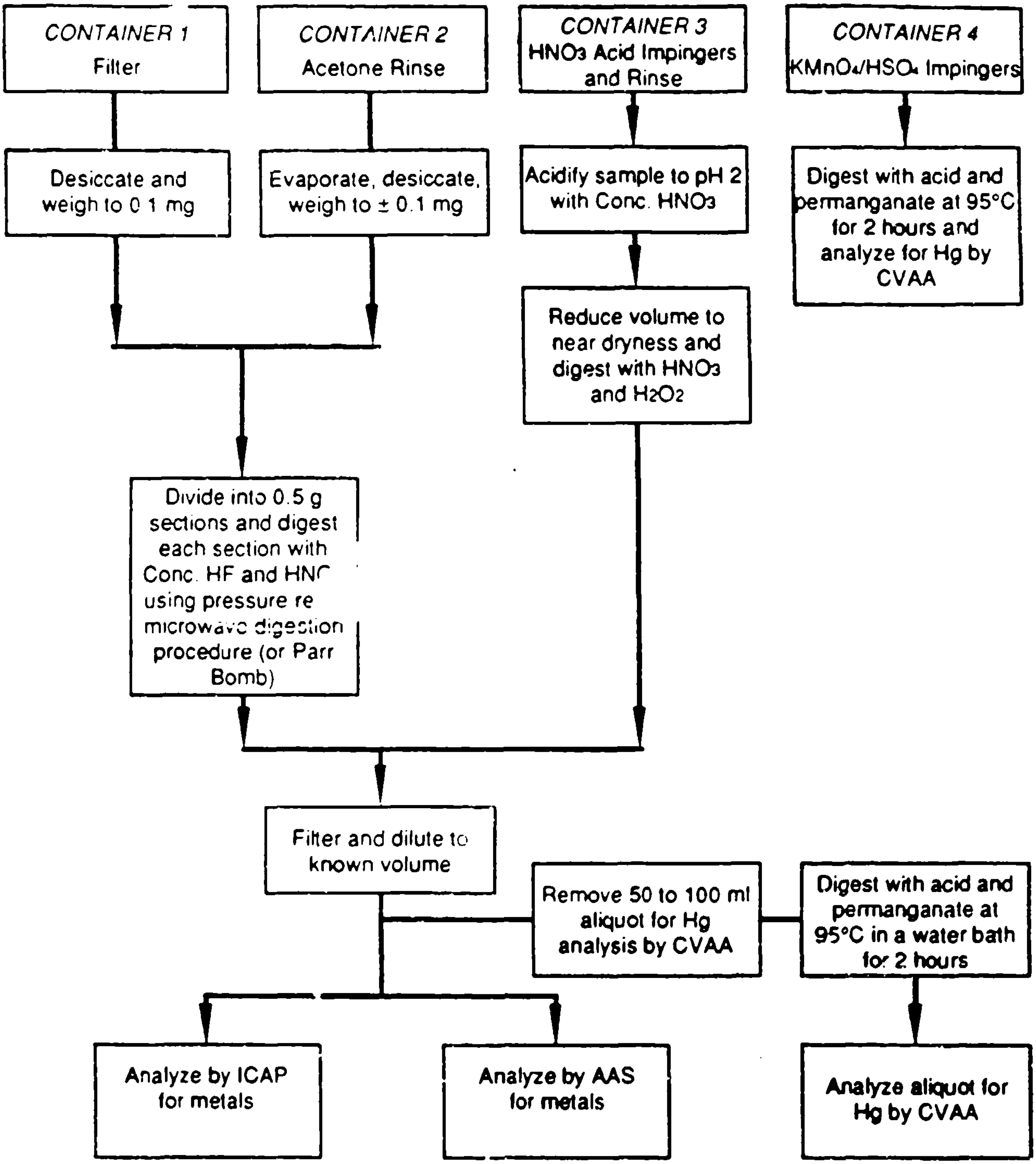


Figure PMM-3. Sample preparation and analysis scheme.

c) 50 mL of hot water is added, and the solution is heated for an additional 20 minutes.

After digestion, the remaining sample is combined with the contents of Container 1. This combined solution of the acid-digested filter, probe, and probe rinse and the impinger contents is filtered by using Whatman 541 filter paper.

The filtered solution is then divided into three fractions. The first fraction is analyzed by inductively coupled argon plasma emission spectroscopy (ICAP) in accordance with EPA Method 200.7 (40 CFR 136, Appendix C) which is the same as Method 6010 from SW 846.* The second fraction is analyzed by graphite furnace atomic absorption spectroscopy (AAS). The third fraction is then digested and analyzed for mercury by cold vapor atomic absorption (CVAA) spectroscopy.

The following list shows the methods normally used for each metal. The listed detection limits are shown in micrograms per sample; actual detection limits will vary depending on blank levels, any dilutions made to account for high levels of metals, or interferences. The detection limit for mercury includes the permanganate fraction.

	Normal procedure			Optional alternate procedure		
Metal	Method	No.*	Nominal detection limit, μg	Method	No.*	Nominal detection limit, μg
Antimony	ICAP	6010	30	AA	7041	2
Arsenic	AA	7060	0.3	-	-	-
Barium	ICAP	6010	0.5	-	-	-
Beryllium	ICAP	6010	0.7	-	-	-
Cadmium	ICAP	6010	1	-	-	-
Chromium	ICAP	6010	3	-	-	-
Copper	-	-	-	ICAP	6010	3
Lead	AA	7421	0.4	ICAP	6010	60
Nickel	-	-	-	ICAP	6010	10
Manganese	-	-	-	ICAP	6010	1
Mercury	AA	7470	0.2	-	-	-
Selenium	-	-	-	AA	7740	0.5
Silver	AA	7761	0.1	-	-	-
Thallium	ICAP	6010	120	AA	7841	0.7
Zinc	-	-	-	ICAP	6010	4

Container No. 4 - A known aliquot of the sample is taken and diluted to approximately 120 mL with mercury-free water. Approximately 15 mL of 50 percent potassium permanganate solution, 5 mL of 50 percent nitric acid, 5 mL of concentrated sulfuric acid, and 9 mL of 5 percent potassium sulfate are added to the sample. The sample is then heated for 2 hours at 95°C in a convection oven or water bath. After cooling, 5 mL of hydroxylamine hydrochloride

* Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW 846, Third Edition, September 1988.

solution is added and mixed with the sample. Then 7 mL of stannous chloride is added and the sample is analyzed for mercury by CVAA spectroscopy.

Normal analytical quality assurance measures include daily full instrument calibration (ICAP is a zero and standard; AAS is a zero and minimum three standards), analysis of a method blank, analysis of a laboratory control sample (LCS, a method blank spiked with a known quantity of each metal), analysis of one sample by ICAP in duplicate, performance of all AAS analyses in duplicate, and performance of a post-digestion spike for each metal analyzed by AAS. For specific projects, a matrix spike may be designated for mercury in the permanganate fraction.

APPENDIX E

CALIBRATION PROCEDURES AND RESULTS

CALIBRATION PROCEDURES AND RESULTS

All of the equipment used is calibrated in accordance with the procedures outlined in the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III.* The following pages describe these procedures and include the data sheets.

*EPA 600/4-77-027b.

Nozzle Diameter

Each nozzle used in these tests is calibrated by making three separate measurements and calculating the average. If a deviation of more than 0.004 inch is found between any two measurements, the nozzle is either discarded or reamed out and remeasured. A micrometer is used for measuring. These calibration data are shown in the following Nozzle Calibration data sheet(s).

NOZZLE CALIBRATION

Date 2-26-91 Calibrated by D. Fitzgerald

Nozzle (Glass) identification number	D_1, in.	D_2, in.	D_3, in.	ΔD, in.	D_{avg}
outlet —	.251	.252	.252	~~.252~~ .001	.252
venturi inlet —	.390	.389	.389	.001	.389
AB Inlet (3-109) (55)	.193	.196	.193	.003	.194
INLET — AB	.172	.170	.171	.002	.171

where:

$D_{1,2,3,}$ = nozzle diameter measured on a different diameter, in. Tolerance = measure within 0.001 in.

ΔD = maximum difference in any two measurements, in. Tolerance = 0.004 in.

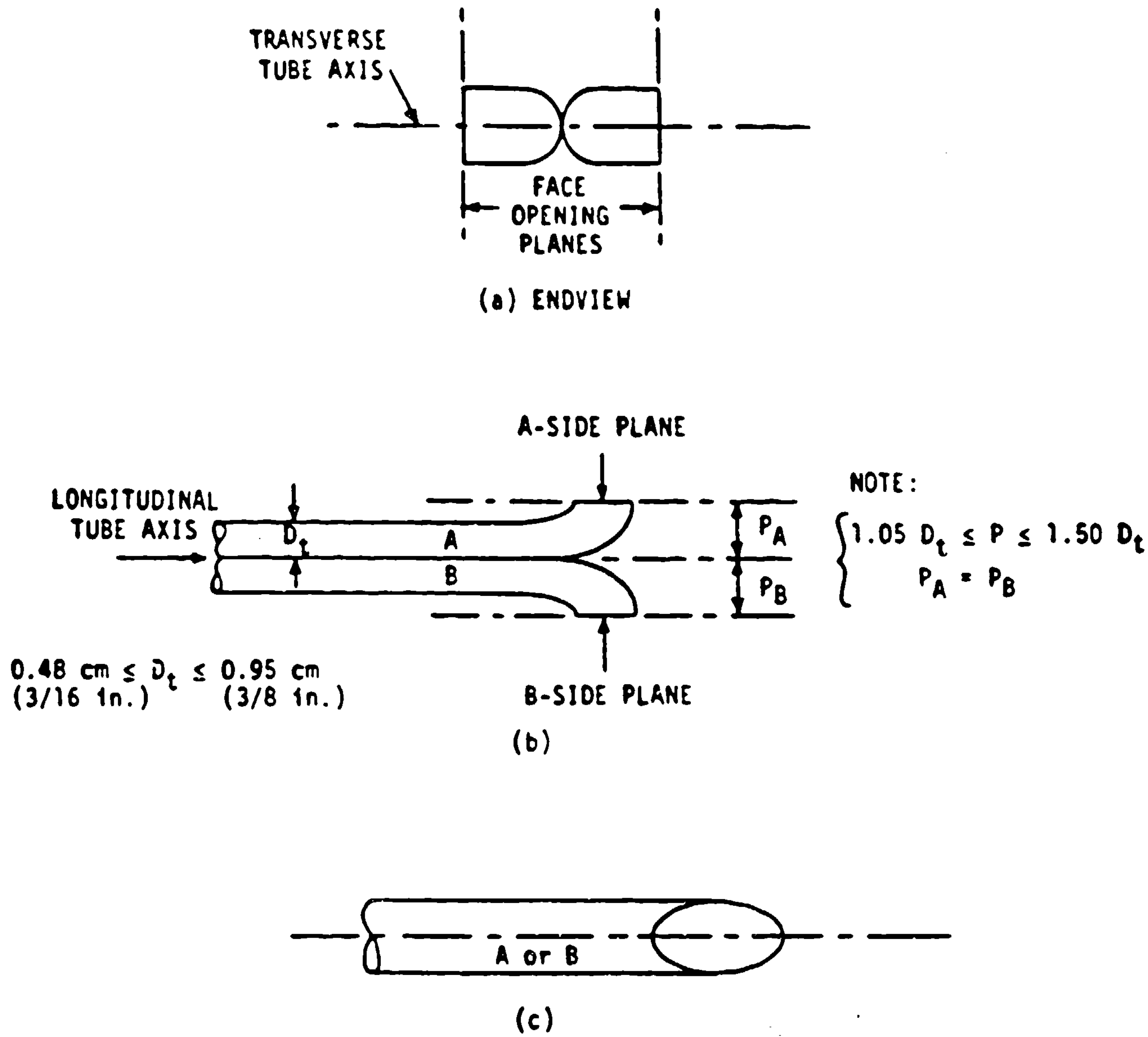
D_{avg} = average of D_1, D_2, and D_3.

Nozzle calibration data.

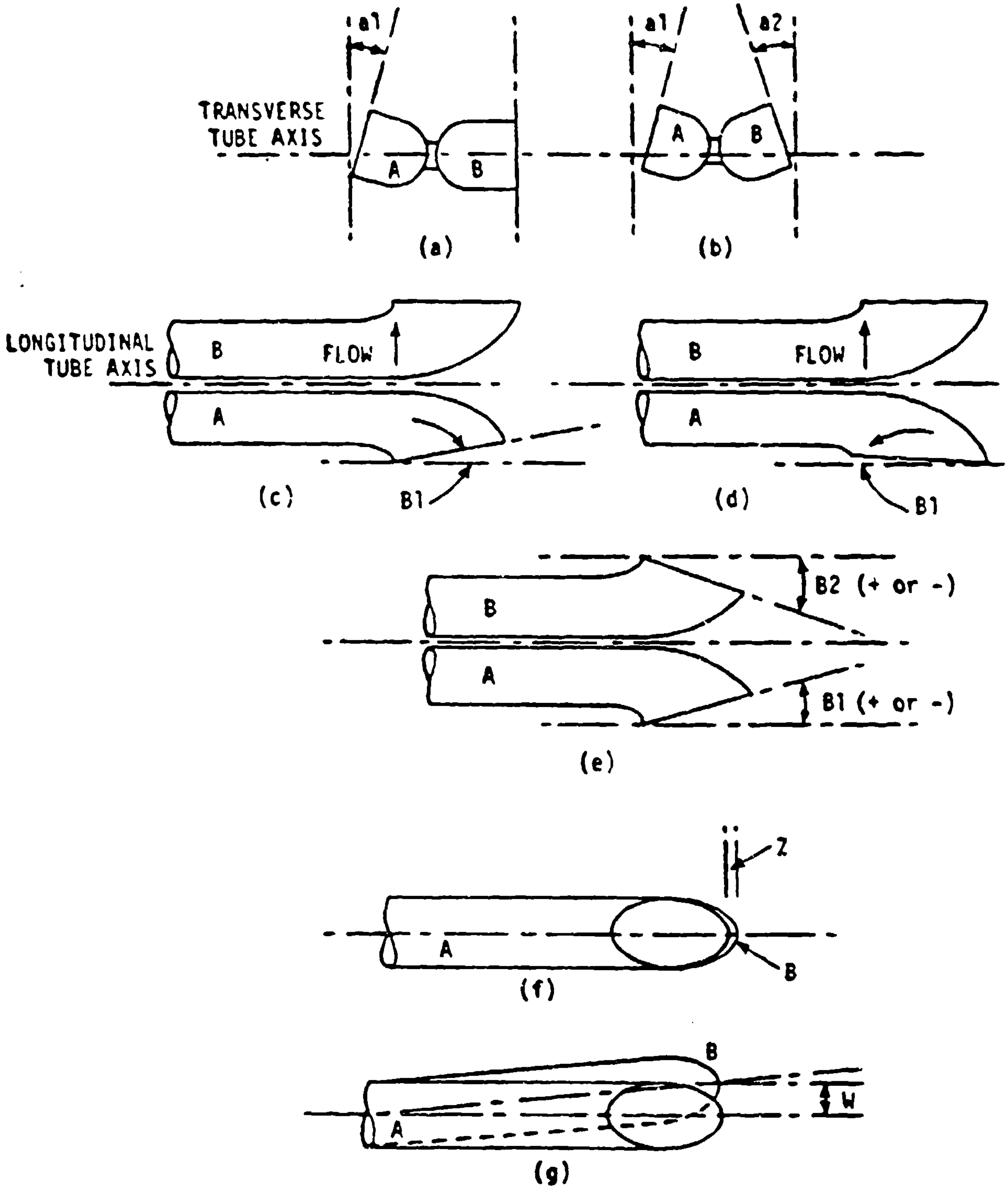
Pitot Tube Calibration

Each pitot tube used in sampling is constructed by ITAQS and meets all requirements of EPA Method 2, Section 4.1.* Therefore, a baseline coefficient of 0.84 is assigned to each pitot tube. The following pages show the alignment requirements of Method 2 and the Pitot Tube Inspection Data Sheet(s) for each pitot tube used during the test program.

*40 CFR 60, Appendix A, July 1989.



Properly constructed Type S pitot tubes shown in: (a) end view, face opening planes perpendicular to transverse axis; (b) top view, face opening planes parallel to longitudinal axis; (c) side view, both legs of equal length and centerlines coincident when viewed from both sides. Baseline coefficient values of 0.84 may be assigned to pitot tubes constructed this way.



Types of face-opening misalignment that can result from field use or improper construction of Type S pitot tubes. These will not affect Cp as long as a_1 and a_2 are $<10^{\circ}$, B_1 and B_2 are $<5^{\circ}$, z is <0.32 (1/8 in.), and w is <0.08 cm (1/32 in.).

INTERNATIONAL TECHNOLOGY CORPORATION

PITOT TUBE INSPECTION DATA SHEET

Pitot Tube No. 501-2 Date 12-6-90 Inspector T. Wicking

α_1 degrees	α_2 degrees	β_1 degrees	β_2 degrees
0	2	1	2
<10°	<10°	<5°	<5°

D_t inches	P inches	1.05 D_t inches	1.50 D_t inches
.375	.996	.394	.563
$0.185 \leq P_t < 0.380$	-	-	-

γ degrees	φ degrees	$P_{\sin(\gamma)}$ inches	$P_{\sin(\varphi)}$ inches
1	1	.017	.017
-	-	<0.125	<0.03125

P_1 inches	P_2 inches	$\lvert P_1 - P_2 \rvert$ inches	Meet specifications
.502	.504	.002	✓
$1.05\ D_t < P_1 < 1.50\ D_t$	$1.05\ D_t < P_2 < 1.50\ D_t$	≤ 0.010	

Lower line in each table is limits for meeting specifications.

Checked by [signature] Date 12/7/90

INTERNATIONAL TECHNOLOGY CORPORATION

PITOT TUBE INSPECTION DATA SHEET

Pitot Tube No. 1'4(-2' Date 12-17-90 Inspector J. Wilkins

α_1 degrees	α_2 degrees	β_1 degrees	β_2 degrees
1	0	1	0
<10°	<10°	<5°	<5°

D_t inches	P inches	$1.05\ D_t$ inches	$1.50\ D_t$ inches
.375	.915	.394	.563
$0.185 \le P_t < 0.380$	-	-	-

γ degrees	φ degrees	$P_{\sin(\gamma)}$ inches	$P_{\sin(\varphi)}$ inches
2	1	.049	.017
-	-	<0.125	<0.03125

P_1 inches	P_2 inches	$\|P_1 - P_2\|$ inches	**Meet specifications**
.457	.458	.001	✓
$1.05\ D_t < P_1 < 1.50\ D_t$	$1.05\ D_t < P_2 < 1.50\ D_t$	≤ 0.010	

Lower line in each table is limits for meeting specifications.

Checked by JM Date 12/17/90

INTERNATIONAL TECHNOLOGY CORPORATION

PITOT TUBE INSPECTION DATA SHEET

Pitot Tube No. 107-3' Date 12-6-90 Inspector J. Wilking

α_1 degrees	α_2 degrees	β_1 degrees	β_2 degrees
0	0	0	0
<10°	<10°	<5°	<5°

D_t inches	P inches	1.05 D_t inches	1.50 D_t inches
.374	.822	.392	.561
$0.185 \leq P_t < 0.380$	-	-	-

γ degrees	φ degrees	$P_{\sin(\gamma)}$ inches	$P_{\sin(\varphi)}$ inches
2	1	.035	.017
-	-	<0.125	<0.03125

P_1 inches	P_2 inches	$\lvert P_1 - P_2 \rvert$ inches	Meet specifications
0.413	.414	.001	✓
$1.05\ D_t < P_1 < 1.50\ D_t$	$1.05\ D_t < P_2 < 1.50\ D_t$	≤0.010	

Lower line in each table is limits for meeting specifications.

Checked by JM Date 12/7/90

Dry Gas Meter and Orifice Meter

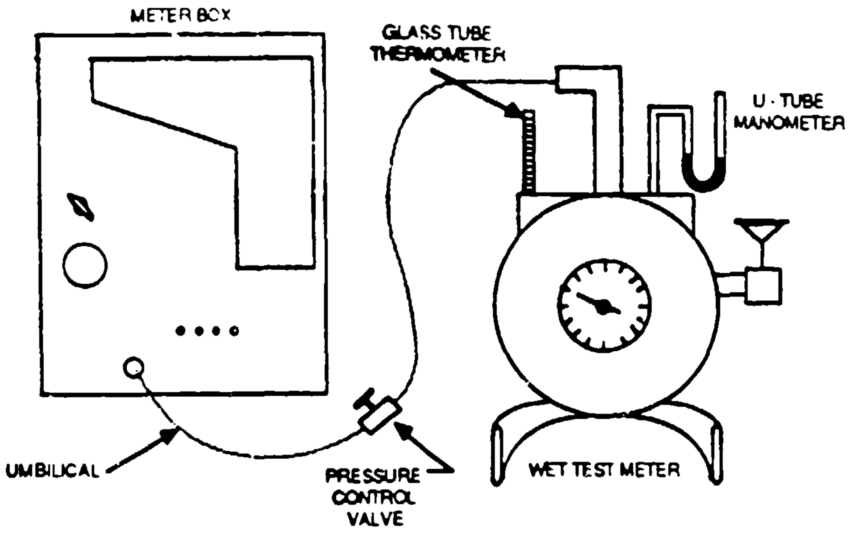
The following page shows the Calibration Setup used for the initial and post-test calibration. A wet-test meter with a 2-cubic-feet-per-minute capacity and ±1 percent accuracy is used. The pump is run for approximately 15 minutes at an orifice manometer setting of 0.5 in.H_2O to heat up the pump and wet the interior surface of the wet-test meter. The information in the following example Calibration Data Sheet is gathered for the initial calibration; the ratio of accuracy of the wet-test meter to the dry-test meter and the ΔH@ are then calculated.

Post-Test Meter Calibration Check

A post-test meter calibration check is made on each meter box used during the test to check its accuracy against the last calibration check. This post-test calibration must be within ±5 percent of the initial calibration. The initial calibration is performed as described in APTD-0576. The post-test calibration is performed by the same method. Three calibration runs are made by using the average orifice setting obtained during each test run and setting the vacuum at the maximum value obtained during each test run. The post-test calibration check indicated that all three runs for each meter box were within the ± 5 percent range allowed by EPA Method 5.*

The Particulate Sampling Meter Box Initial Calibration and Post-Test Calibration data sheets are included in the following pages.

* 40 CFR 60, Appendix A, July 19[illegible]



Calibration setup.

DATE ______________________ METER BOX NO ______________________

BAROMETRIC PRESSURE, P_b = ________ in. Hg DRY GAS METER NO. ______________________

ORIFICE MANOMETER SETTING ΔH in. H_2O	GAS VOLUME WET TEST METER V_w ft^3	GAS VOLUME DRY GAS METER V_d ft^3	WET TEST METER T_w °F	DRY GAS METER INLET t_{d_i} °F	DRY GAS METER OUTLET t_{d_o} °F	DRY GAS METER AVERAGE t_d °F	TIME ⊘ min	Y	$\Delta H@$
0.5	5								
1.0	5								
1.5	10								
2.0	10								
3.0	10								
4.0	10								

AVERAGE ________

ΔH	$\frac{\Delta H}{13.6}$	Y: $\frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$	$\Delta H@$: $\frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\oslash}{V_w}\right]^2$
0.5	0.0368		
1.0	0.0737		
1.5	0.110		
2.0	0.147		
3.0	0.221		
4.0	0.294		

Y = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ± 0.01

$\Delta H@$ = Orifice of pressure differential that gives 0.75 cfm of air at 70° F and 29.92 inches of mercury, in H_2O). Tolerance = ± 0.15

Calibration data sheet.

INTERNATIONAL TECHNOLOGY CORPORATION

METER BOX INITIAL CALIBRATION

validated 11/8/90

Date: 10/9/90 Meter Box No.: FT-2

Barometric Pressure, (Pbar): 29.42 Calibrator: . Yarbrough

Run No.	Orifice manometer setting* ΔH in. H2O	Wet test meter volume Vw ft3	Dry gas meter volume Vd ft3	Temperatures: Wet test meter Tw °F	Temperatures: Dry gas meter Inlet Tdi °F	Temperatures: Dry gas meter Outlet Tdo °F	Average Td °F	Vacuum setting** in. Hg	Duration of run, Ø min.	Duration of run, Ø sec
			121.793	72	78	74				
1	0.50	10.000	131.912	72	78	75	76.3	10	21	57
			132.741	72	78	75				
2	1.00	12.000	144.938	72	81	75	77.3	10	18	54
			151.288	72	81	75				
3	1.50	10.000	161.439	72	81	75	78.0	10	12	54
			162.807	72	81	75				
4	2.00	10.000	172.936	71	80	75	77.8	10	11	8
			174.083	71	78	76				
5	3.00	13.000	187.214	71	78	75	76.8	10	11	52
			188.010	71	78	75				
6	4.00	10.000	198.100	71	79	75	76.8	10	7	58

Run No.	Y	ΔH@
1	0.995	1.37
2	0.991	1.41
3	0.993	1.41
4	0.994	1.40
5	0.993	1.41
6	0.992	1.44
Pretest average	0.993	1.41
Difference*=	0.00	0.07

$$y = \frac{(Vw)(Pbar)(Td+460)}{(Vd)(Pbar+\Delta H/13.6)(Tw+460)}$$

$$\Delta H = \frac{(0.0317)(\Delta H)}{(Pbar)(Td+460)} \times \left|\frac{(Tw+460)\ (\text{Ø})}{Vw}\right|^2$$

* Y must not deviate by more than ±0.02Y.
ΔH@ difference ≤0.15 in.H2O = Maximum ΔH@ - Minimum ΔH@

Data checked by: [signature]
Date: 11/21/90

INTERNATIONAL TECHNOLOGY CORPORATION

METER BOX POST-TEST CALIBRATION

Date:	3/11/91	Meter Box No.:	FT-2	
Barometric Pressure, (Pbar):	29.71	Initial Y:	0.992	ΔH@: 1.41
Plant:	RRAD	Project No.:	805625	
Project Manager:	Bratfey	Calibrator:	Graves	

Run No.	Orifice manometer setting* ΔH in H2O	Wet test meter volume Vw ft3	Dry gas meter volume Vd ft3	Temperatures: Wet test meter Tw °F	Temperatures: Dry gas meter Inlet Tdi °F	Temperatures: Dry gas meter Outlet Tdo °F	Temperatures: Dry gas meter Average Td °F	Vacuum setting** in. Hg	Duration of run, Ø min.	Duration of run, Ø sec
			220.598	66	82	78				
1	0.75	10.000	231.353	66	88	79	81.8	15	18	22
			231.353	66	88	79				
2	0.75	10.000	242.116	66	91	81	84.8	15	18	18
			242.116	66	91	81				
3	0.75	11.000	253.961	66	92	82	86.5	15	20	17

Run No.	Y	ΔH@
1	0.956	1.41
2	0.960	1.36
3	0.963	1.38
Post-test average***	0.960	1.38
Difference from Pretest ***=	-0.032	-0.03

$$Y = \frac{(Vw)(Pbar)(Td+460)}{(Vd)(Pbar+\Delta H/13.6)(Tw+460)}$$

$$\Delta H@ = \frac{(0.0317)(\Delta H)}{(Pbar)(Td+460)} \times \left[\frac{(Tw+460)(\Theta)}{Vw}\right]^2$$

* To be the average ΔH used during the test series.
** To be the highest vacuum used during the test series.
*** Post-test Y must be within ±0.05 initial Y.
ΔY = (Posttest Y - Initial Y) / Initial Y
Post-test ΔH@ must be within ±0.15 in.H2O of the initial ΔH@.
ΔH@ difference = Posttest ΔH@ - Initial ΔH@

Data checked by: JM
Date: 3/11/91

INTERNATIONAL TECHNOLOGY CORPORATION

validated 11/8/90

METER BOX INITIAL CALIBRATION

Date: 11/6/90

Barometric Pressure, (Pbar): 29.62

Meter Box No.: FT-4

Calibrator: R. Kolde

Run No.	Orifice manometer setting* ΔH in. H2O	Wet test meter volume Vw ft3	Dry gas meter volume Vd ft3	Temperatures: Wet test meter Tw °F	Dry gas meter Inlet Tdi °F	Dry gas meter Outlet Tdo °F	Average Td °F	Vacuum setting** in. Hg	Duration of run, Ø min.	sec
1	0.50	5.000	58.700	67	72	69	70.8	10	13	11
			63.854	67	72	70				
2	1.00	10.000	64.300	67	72	70	71.3	10	18	40
			74.587	67	73	70				
3	1.50	10.000	74.800	67	73	70	71.8	10	15	32
			85.109	67	74	70				
4	2.00	10.000	85.400	67	74	70	72.3	10	13	39
			95.713	67	74	71				
5	3.00	10.000	96.300	67	74	71	72.5	10	11	11
			106.615	67	74	71				
6	4.00	10.000	107.100	67	74	71	72.5	10	9	38
			117.426	67	74	71				

Run No.	Y	ΔH@
1	0.976	1.95
2	0.978	1.95
3	0.975	2.02
4	0.974	2.08
5	0.972	2.09
6	0.969	2.07
Pretest average	0.974	2.03
Difference*=	0.01	0.15

$$y = \frac{(Vw)(Pbar)(Td+460)}{(Vd)(Pbar+\Delta H/13.6)(Tw+460)}$$

$$\Delta H = \frac{(0.0317)(\Delta H)}{(Pbar)(Td+460)} \times \left|\frac{(Tw+460)\ (Ø}{V}\right.$$

Data checked by: [signature]

Date: 11/21/90

* Y must not deviate by more th[illegible] ±0.02Y.

ΔH@ difference ≤0.15 in H2O = Maximum ΔH@ - Minimum ΔH@

INTERNATIONAL TECHNOLOGY CORPORATION

METER BOX POST-TEST CALIBRATION

Date:	3/8/91	Meter Box No.:	FT-4		
Barometric Pressure, (Pbar):	29.62	Initial Y:	0.974	ΔH@:	2.03
Plant:	R.R.A.D.	Project No.:	805625		
Project Manager:	BRUFFEY	Calibrator:	Graves		

Run No.	Orifice manometer setting* ΔH in. H2O	Wet test meter volume Vw ft3	Dry gas meter volume Vd ft3	Temperatures: Wet test meter Tw °F	Temperatures: Dry gas meter Inlet Tdi °F	Temperatures: Dry gas meter Outlet Tdo °F	Temperatures: Dry gas meter Average Td °F	Vacuum setting** in. Hg	Duration of run, Ø min.	Duration of run, Ø sec
			43.421	66	79	73				
1	1.60	12.000	55.937	66	80	75	76.8	6	18	21
			55.937	66	80	75				
2	1.60	10.000	66.423	66	81	76	78.0	6	15	18
			66.423	66	81	76				
3	1.60	10.000	76.922	66	83	78	79.5	6	15	19

Run No.	Y	ΔH@
1	0.974	2.06
2	0.972	2.06
3	0.973	2.06
Post-test average***	0.973	2.06
Difference from Pretest ***=	-0.001	0.03

$$Y = \frac{(Vw)(Pbar)(Td+460)}{(Vd)(Pbar+\Delta H/13.6)(Tw+460)}$$

$$\Delta H@ = \frac{(0.0317)(\Delta H)}{(Pbar)(Td+460)} \times \left[\frac{(Tw+460)\ (Ø)}{Vw}\right]^2$$

* To be the average ΔH used during the test series.
** To be the highest vacuum used during the test series.
*** Post-test Y must be within ±0.05 initial Y.
ΔY = (Posttest Y - Initial Y) / Initial Y
Post-test ΔH@ must be within ±0.15 in.H2O of the initial ΔH@.
ΔH@ difference = Posttest ΔH@ - Initial ΔH@

Data checked by: JM
Date: 3/8/91

INTERNATIONAL TECHNOLOGY CORPORATION

validated 11/8/90

METER BOX INITIAL CALIBRATION

Date: 12/10/90
Barometric Pressure, (Pbar): 29.65
Meter Box No.: FT-11
Calibrator: J. Neese

Run No.	Orifice manometer setting* ΔH in. H2O	Wet test meter volume Vw ft3	Dry gas meter volume Vd ft3	Temperatures: Wet test meter Tw °F	Dry gas meter: Inlet Tdi °F	Dry gas meter: Outlet Tdo °F	Average Td °F	Vacuum setting** in. Hg	Duration of run, Ø min.	sec
1	0.50	8.000	192.173	69	79	73	75.5	10	20	15
			200.409	69	77	73				
2	1.00	10.000	200.915	69	77	73	75.0	10	18	7
			211.198	69	77	73				
3	1.50	13.000	211.728	69	77	73	75.3	10	19	6
			225.092	69	78	73				
4	2.00	10.000	177.316	69	79	73	76.0	10	12	32
			187.617	69	79	73				
5	3.00	10.000	225.524	69	78	73	75.8	10	10	18
			235.788	69	79	73				
6	4.00	10.000	236.427	69	79	73	76.5	10	8	56
			246.709	69	80	74				

Run No.	Y	ΔH@
1	0.982	1.79
2	0.981	1.84
3	0.981	1.81
4	0.979	1.7[illegible]
5	0.979	1.78
6	0.977	1.78
Pretest average	0.980	1.79
Difference*=	0.00	0.08

$$y = \frac{(Vw)(Pbar)(Td+460)}{(Vd)(Pbar+\Delta H/13.6)(Tw+460)}$$

$$\Delta H@ = \frac{(0.0317)(\Delta H)}{(Pbar)(Td+460)} \times \left[\frac{(Tw+460)\ (Ø)}{Vw}\right]^2$$

Data checked by: [signature]
Date: 12-10-90

* Y must not deviate by more than ±0.02Y.
ΔH@ difference ≤0.15 in.H2O = Maximum ΔH@ - Minimum ΔH@

INTERNATIONAL TECHNOLOGY CORPORATION

METER BOX POST-TEST CALIBRATION

Date:	2/8 91	Meter Box No.:	FT-11
Barometric Pressure, (Pbar):	27.62	Initial Y:	0.980
Plant:	R F A D.	Project No.:	805625
Project Manager:	Bruffey	Calibrator:	Graves

ΔH@: 1.79

Run No.	Orifice manometer setting* ΔH in H2O	Wet test meter volume Vw ft3	Dry gas meter volume Vd ft3	Temperatures: Wet test meter Tw °F	Dry gas meter Inlet Tdi °F	Dry gas meter Outlet Tdo °F	Average Td °F	Vacuum setting** in Hg	Duration of run, Ø min	Duration of run, Ø sec
1	0.95	10.000	167.129	66	62	76	78.8	5	18	36
			177.523	66	81	76				
2	0.95	10.000	177.523	66	81	76	78.5	5	18	34
			187.915	66	81	76				
3	0.95	11.000	187.915	66	81	76	78.5	5	20	33
			199.372	66	81	76				

Run No.	Y	ΔH@
1	0.983	1.81
2	0.983	1.80
3	0.981	1.82
Post-test average***	0.982	1.81
Difference from Pretest ***=	0.002	0.02

$$Y = \frac{(Vw)(Pbar)(Td+460)}{(Vd)(Pbar+\Delta H/13.6)(Tw+460)}$$

$$\Delta H@ = \frac{(0.0317)(\Delta H)}{(Pbar)(Td+460)} \times \left[\frac{(Tw+460)\ (Ø)}{Yw}\right]^2$$

* To be the average ΔH used during the test series.
** To be the highest vacuum used during the test series.
*** Post-test Y must be within ± 0.05 initial Y.
ΔY = (Posttest Y - Initial Y) / Initial Y
Post-test ΔH@ must be within ± 0.15 in.H2O of the initial ΔH@.
ΔH@ difference = Posttest ΔH@ - Initial ΔH@

Data checked by: [signature]
Date: 3/8/91

Stack Thermocouples

Each thermocouple is calibrated by comparing it with an ASTM-3F thermometer at approximately 32°F, ambient temperature, 100°F, and 500°F. The thermocouple read within 1.5 percent of the reference thermometer throughout the entire range when expressed in degrees Rankine. The thermocouples may be checked at ambient temperature at the test site to verify the calibration. Calibration data are included in the following Thermocouple Calibration Data Sheet(s).

INTERNATIONAL TECHNOLOGY CORPORATION

THERMOCOUPLE CALIBRATION DATA SHEET

Date: 12/26/90 Thermocouple No: 271

Calibrator: 13.5 Reference: ASTM-3F

Range: 2'

Reference point no.	Source*	Reference thermometer temperature °F	Thermocouple temperature °F	Difference %**
1	2	70	68	.38
2	1	38	37	.20
3	3	210	212	.30
4	4	448	445	.33

* Source: 1) Ice bath
2) Ambient
3) Water bath
4) Oil bath

** Percent difference.

$$\frac{\text{Reference temp. °R - thermocouple temp. °R}}{\text{(Reference temp. °R)}} \times 100\%$$

where °R = °F + 460

Each percent difference must be less than or equal to 1.5%.

Checked by JM Date 12/26/90

Digital Indicators for Thermocouple Readout

A digital indicator is calibrated by feeding a series of millivolt signals to the input and comparing the indicator reading with the reading the signal should have generated. Error did not exceed 0.5 percent when the temperatures were expressed in degrees Rankine. Calibration data are included in the following Thermocouple Digital Indicator Calibration Data Sheet(s).

THERMOCOUPLE DIGITAL INDICATOR
CALIBRATION DATA SHEET

DATE: 10/19/90 INDICATOR NO: FI-2

OPERATOR: [illegible] SERIAL NO: 3

CALIBRATION DEVICE NO: - MANUFACTURER: Omega

TEST POINT NO.	MILLIVOLT SIGNAL	EQUIVALENT TEMPERATURE, deg. F	DIGITAL INDICATOR TEMPERATURE READING, deg. F	DIFFERENCE %
1	-0.692	0	0	0
2	1.520	100	100	0
3	3.819	200	199	0.15
4	6.092	300	300	0
5	8.314	400	397	0.35
6	10.560	500	499	0.10
7	22.251	1000	998	0.14
8	29.315	1300	1297	0.17
9	36.156	1600	1595	0.24
10	42.732	1900	1895	0.21

Avg. 0.136

Percent difference must be less than or equal to 0.5%

Percent difference:

$$\frac{(\text{Equivalent temperature, deg. R} - \text{Digital indicator temperature, deg. R})(100\%)}{(\text{Equivalent temperature, deg. R})}$$

Where, deg. R = deg. F + 460

INTERNATIONAL TECHNOLOGY CORPORATION

DIGITAL INDICATOR CALIBRATION DATA SHEET

DATE: 1-31-91 INDICATOR: FT-4

OPERATOR: J Wilking

Test Point Number	Equivalent Temperature, °F T_e	Digital Indicator Temperature, °F T_{dl}	Difference,* %
1	0	-1	.22
2	100	98	.36
3	200	199	.15
4	300	298	.26
5	400	396	.47
6	500	497	.31
7	1000	995	.34
8	1300	1293	.40
9	1600	1592	.39
10	1900	1889	.47

*PERCENT DIFFERENCE MUST BE LESS THAN OR EQUAL TO 0.5%

$$\%\text{DIFFERENCE} = \frac{(T_e, {}^\circ R - T_{dl}, {}^\circ R)(100)}{T_e, {}^\circ R}$$

Where, °R = °F + 460

Checked By JM Date 1/31/91

THERMOCOUPLE DIGITAL INDICATOR
CALIBRATION DATA SHEET

DATE: 12/3/90 INDICATOR NO: FT-11

OPERATOR: R. Kolda SERIAL NO:

CALIBRATION DEVICE NO: 3 MANUFACTURER: OMEGA

TEST POINT NO.	MILLIVOLT SIGNAL	EQUIVALENT TEMPERATURE, deg. F	DIGITAL INDICATOR TEMPERATURE READING, deg. F	DIFFERENCE %
1	-0.692	0	-1	.22
2	1.520	100	99	.18
3	3.819	200	200	0
4	6.092	300	300	0
5	8.314	400	398	.23
6	10.560	500	500	0
7	22.251	1000	1000	0
8	29.315	1300	1299	.06
9	35.166	1600	1599	.05
10	42.732	1900	1898	.08

Percent difference must be less than or equal to 0.5%

Percent difference:

$$\frac{(\text{Equivalent temperature, deg. R} - \text{Digital indicator temperature, deg. R})(100\%)}{(\text{Equivalent temperature, deg. R})}$$

Where, deg. R = deg. F + 460

12/7/90
GM

Dry Gas Thermocouples and Impinger Thermocouples

The dry gas thermocouples are calibrated by comparing them with an ASTM-3F thermometer at approximately 32°F, ambient temperature, and a higher temperature between approximately 100° and 200°F. The thermocouples agreed within 5°F of the reference thermometer. The impinger thermocouples are checked in a similar manner at approximately 32°F and ambient temperature, and they agreed within 2°F. The thermocouples may be checked at ambient temperature prior to the test series to verify calibration. Calibration data are included in the following Dry Gas Thermometer and Impinger Thermocouple Calibration Data Sheet(s).

DRY GAS THERMOCOUPLE
CALIBRATION DATA SHEET

Date: 10/9/90 Thermocouple No: FT-2

Calibrator: T. [illegible] Reference: ASTM-3F

INLET

Reference point No.	Source'	Reference thermometer temperature deg. F	Thermocouple temperature deg. F	Difference deg. F''
1	1	71	70	1
2	2	33	34	1
3	3	136	138	2

OUTLET

Reference point No.	Source'	Reference thermometer temperature deg. F	Thermocouple temperature deg. F	Difference deg. F''
1	1	71	71	0
2	2	33	34	1
3	3	136	138	2

'Sources: 1 - Ambient
2 - Ice bath
3 - Water bath

'' Difference must be less than 5 deg. F at both points

DRY GAS THERMOCOUPLE
CALIBRATION DATA SHEET

Date: 11/6/90 Thermocouple No: FT-4

Calibrator: R. Kolde Reference: ASTM-3F Thermometer

INLET

Reference point No.	Source*	Reference thermometer temperature deg. F	Thermocouple temperature deg. F	Difference deg. F**
1	1	65	66	1
2	2	33	33	0
3	3	200	201	1

OUTLET

Reference point No.	Source*	Reference thermometer temperature deg. F	Thermocouple temperature deg. F	Difference deg. F**
1	1	65	65	0
2	2	33	33	0
3	3	200	200	0

*Source: 1 - Ambient
2 - Ice bath
3 - Water bath

**Difference must be less than 5 deg. F at both points

DRY GAS THERMOCOUPLE CALIBRATION DATA SHEET

Date: 12-4-90 Thermocouple No: FT-11

Calibrator: T. G[illegible] Reference: ASTM-3-F

INLET

Reference point No.	Source'	Reference thermometer temperature deg. F	Thermocouple temperature deg. F	Difference deg. F''
1	1	66	65	1
2	2	36	36	0
3	3	156	156	0

OUTLET

Reference point No.	Source'	Reference thermometer temperature deg. F	Thermocouple temperature deg. F	Difference deg. F''
1	1	66	65	1
2	2	36	36	0
3	3	156	156	0

' Source: 1. Ambient
2. Ice bath
3. Water bath

'' [illegible]

12/7/90 [illegible]

INTERNATIONAL TECHNOLOGY CORPORATION

IMPINGER THERMOCOUPLE CALIBRATION DATA SHEET

Date: 12/14/90 Thermocouple No: I-2

Calibrator: T. Yarbrough Reference: ASTM-3F

Reference point no.	Source*	Reference thermometer temperature °F	Thermocouple temperature °F	Difference °F**
1	1	70	71	1
2	2	34	34	0

* Source: 1) Ambient
2) Ice bath

** Difference must be less than 2°F at both points.

Checked by JM Date 12/14/90

INTERNATIONAL TECHNOLOGY CORPORATION

IMPINGER THERMOCOUPLE CALIBRATION DATA SHEET

Date: 12/14/90 Thermocouple No: I-5

Calibrator: T. Yarbrough Reference: ASTM-3F

Reference point no.	Source*	Reference thermometer temperature °F	Thermocouple temperature °F	Difference °F**
1	1	70	70	0
2	2	33	34	1

* Source: 1) Ambient
2) Ice bath

** Difference must be less than 2°F at both points.

Checked by [signature] Date 12/14/90

INTERNATIONAL TECHNOLOGY CORPORATION

IMPINGER THERMOCOUPLE CALIBRATION DATA SHEET

Date: 12-26-90 Thermocouple No: I-32

Calibrator: T. Yarbough Reference: ASTM-3F

Reference point no.	Source*	Reference thermometer temperature °F	Thermocouple temperature °F	Difference °F**
1	1	69	69	0
2	2	35	34	1

* Source: 1) Ambient
2) Ice bath

** Difference must be less than 2°F at both points.

Checked by Jm Date 12/26/90

Trip Balance

The trip balance is calibrated by comparing it with Class-S standard weights, and it agreed within 0.5 g. Calibration data are shown in the following Trip Balance Calibration Data Sheet(s).

INTERNATIONAL TECHNOLOGY CORPORATION

TRIP BALANCE CALIBRATION DATA SHEET

Balance No.	Date	Calibrator	Mass determined for 5 g	Error	50 g	Error	100 g	Error
419	12/14/90	BJ Graves	5.3	0.3	50.3	0.3	100.2	0.2
420	12/14/90	BJ Graves	5.0	0.0	50.0	0.0	100.1	0.1
421	12/14/90	BJ Graves	5.1	0.1	50.1	0.1	100.1	0.1
422	12/14/90	BJ Graves	5.1	0.1	50.1	0.1	100.1	0.1
418	12/14/90	BJ Graves	5.0	0.0	50.1	0.1	100.0	0.0
199	12/14/90	BJ Graves	5.0	0.0	50.0	0.0	100.0	0.0
* Mettler	12/14/90	BJ Graves	5.0	0.0	50.0	0.0	100.0	0.0

Error must not exceed 0.5 grams at each point.

*- used @ RRAD.

Checked by JM Date 12/14/90

Barometer

The field barometer is calibrated to within 0.1 in.Hg of an NBS-traceable mercury-in-glass barometer before the test series. It is checked against the reference barometer after each test series to determine if it reads within 0.2 in.Hg. The barometer read within the allowable limits each time. Calibration data are included in the following Barometer Calibration Log(s).

BAROMETER CALIBRATION LOG

BAROMETER NO.	412	410	411	414	~~419~~	410	410
	G.E. MtVernon	Central State Can	P+G 332015	USAirMail Texas		CG+E	Sherwin Williams
PRETEST							
BAROMETER READING	29.55	29.04	28.76	29.44	~~29.44~~	29.15	28.78
REFERENCE BAROMETER READING	29.57	29.03	28.78	29.44	~~29.44~~	29.19	28.76
DIFFERENCE*	.00	.01	0.02	0.00	~~0.00~~	0.01	.02
DATE	2/11/91	2/13/91	2/14/91	2/19/90		3/4/91	3/6/91
CALIBRATOR	MK	M. Koetter	[illegible]	M. Koetter		[illegible]	[illegible]
POST-TEST							
BAROMETER READING	29.54	29.51	29.04	29.68		28.78	
REFERENCE BAROMETER READING	29.51	29.51	29.01	29.70		28.76	
DIFFERENCE**	.03	.00	0.03	.02		.02	
DATE	2/27/91	2/27/91	3/13/91	3-11-91		3/6/91	
CALIBRATOR	BJ	BJ	BJ	JW		[illegible]	

*Barometer is adjusted so that difference does not exceed 0.05 in. Hg.
**Barometer is not adjusted. If difference exceed 0.10 in. Hg, inform project manager immediately.

END

FILMED

DATE: 5-92

DTIC